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To	DFDR Subcommittee	**Date**	December 5, 2014
From	P. J. Prisaznuk pjp@sae-itc.org tel 1-410-212-0913	**Reference**	14-156/DFDR-175 lth

Subject

Draft Circulation
Draft 1 of Supplement 6 to ARINC Characteristic 757: *Cockpit Voice Recorder (CVR)*

Summary

Supplement 6 to ARINC Characteristic 757A was prepared by the ARINC IA staff from inputs provided during web conferences held in 2013.

Technical Changes in Yellow:

The technical changes are summarized as follows:

- The On-board Maintenance System (OMS) interface is clarified to be an optional ARINC 429 interface.
- The Recorder Status Word sent to the OMS was updated.
- Sign Status Matrix (SSM) updated per ARINC Specification 429
- Recorder Independent Power Supply (RIPS) guidance was updated.
- Notes pertaining to aircraft interwiring have been updated.

Technical changes to this draft are shown in blue bold ~~(and red strikeout)~~ with yellow highlight.

Document Alignment Changes in Gray:

Supplement 6 introduces a small number of changes as a result of the pending Supplement 1 to ARINC Characteristic 757A. Because these documents are closely related, Supplement 6 includes a few changes which are intended to align the documents.

Changes intended to align ARINC 757 and ARINC 757A are shown in blue bold ~~(and red strikeout)~~ with gray highlight. These changes have already been approved for inclusion in ARINC Characteristic 757A.

Action

This draft will be reviewed at the ad hoc CVR Working Group meeting to be held February 10-12, 2015 in Sarasota, Florida. Comments on the attached draft are invited. They should be directed to Paul Prisaznuk before **January 15, 2015.**

Preamble:

When this Supplement has been completed, adopted and published, Sections A, B and C will be affixed to the end of the published Characteristic. These pages, currently numbered a, b, c…, are used to explain the changes that will be made by this draft Supplement. The content of Sections A, B and C is under development in parallel with the changes to the body of the existing standard. Therefore, changes to their content are shown in blue bold in the same manner as changes to the body of the document.

Section A is written as it is expected to read when the Supplement is mature.

When the changes developed in this Supplement are integrated into the existing standard, they will be identified by blue bold.

Section C contains a cumulative list of entries describing the changes to be incorporated by this Supplement. Typically, Section C expands in size with each draft.

DRAFT 1 OF
SUPPLEMENT 6 TO
ARINC CHARACTERISTIC 757
COCKPIT VOICE RECORDER (CVR)

Published: Month Day, Year

Prepared by the AEEC

PURPOSE OF THIS DOCUMENT

This supplement was prepared for the purpose of redefining the ARINC 429 recorder status data word format used with Cockpit Voice Recorder (CVR) communications with the On-board Maintenance System (OMS). Additionally, notes pertaining to CVR interwiring were updated to describe CVR grounding requirements. This document is aligned to ARINC Characteristic 757A, also a CVR standard.

B. ORGANIZATION OF THIS SUPPLEMENT

In this document **blue bold** text is used to indicate those areas of text changed by the current supplement only.

C. CHANGES TO ARINC CHARACTERISTIC 757 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete listing of the changes to the document introduced by this supplement. Each change is identified by the section number and the title as it will appear in the complete document. Where necessary, a brief description of the change is included.

1.2.2 Relationship to ARINC Characteristic 757A

This section was renumbered and updated to clarify the role of the OMS interface, which is optional in ARINC Characteristic 757, but not optional in ARINC Characteristic 757A.

1.2.3 Relationship to ARINC Characteristic 747

This section was renumbered.

1.2.5 Relationship to ARINC Specification 429

This section was renumbered and updated to describe optional OMS interface considerations.

2.4 Primary Power Input

This section clarifies the need for the CVR to be designed to accept 115 Vac power and 28 Vdc power from the aircraft. Only one source will be used.

3.5.1 Minimum Requirements

The Commentary on switches and lamp loads was corrected for accuracy.

3.5.8 OMS Compatibility (Optional)

This section was updated to say that when this function is implemented, then it shall be implemented in a specific way.

3.9 Data Link Communication (Optional)

This section was updated to say that when this function is implemented, then it shall be implemented in a specific way.

4.0 Provisions for Test

This section was updated to say that when this function is implemented, then it shall be implemented in a specific way.

ATTACHMENT 2 – CVR INTERWIRING DIAGRAM WITH REMOTE MICROPHONE (AC POWER SHOWN)

The drawing was modified to remove the direct wiring of ground connections between the CVR and the control unit. Each is grounded to the airframe within 1 foot of the connector.

ATTACHMENT 3 – CVR INTERWIRING DIAGRAM WITH REMOTE MICROPHONE (DC POWER SHOWN)

The drawing was modified to remove the direct wiring of ground connections between the CVR and the control unit. Each is grounded to the airframe within 1 foot of the connector.

The drawing showing the “AREA MIC” connection previously called out Note 12 in error. This is now corrected to read Note 11.

ATTACHMENT 6 – NOTES TO STANDARD INTERWIRING

Note 8, Chassis Ground Connection was expanded with new language provided.

ATTACHMENT 12 – NOTES TO CONTROL UNIT STANDARD INTERWIRING

Note 5 was updated to correct a typographical error in the pin call-outs for Crew Area Microphone (CAM) gain selection, now reading: “pins p, r, or t.”

ATTACHMENT 19 – RECORDER STATUS/OMS COMMAND WORD FORMAT

This attachment contains the definition of the Recorder Status Word, per ARINC 429 label 350. Bit 23 is defined as the “FDR/CVR Inhibit” discrete.

The Sign Status Matrix (SSM) bits 30 and 31 were aligned to that defined by ARINC Specification 429.

ATTACHMENT 20 – FAULT AND STATUS OUTPUT CONDITIONS

The table was revised to reflect changes in the Recorder Status Word defined by Attachment 19.

APPENDIX E – INTERNAL OR EXTERNAL RIPS IMPLEMENTATION

The guidance provided in this section was aligned to ARINC Characteristic 757A.

APPENDIX G – ACRONYMS AND ABBREVIATIONS

This section added by Supplement 6.

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DRAFT 1 OF
SUPPLEMENT 6 TO
ARINC CHARACTERISTIC 757
COCKPIT VOICE RECORDER (CVR)

This draft dated: December 5, 2014

APPENDICES

1.0 INTRODUCTION

1.1 Purpose of this Document

This document is intended to provide design guidance for the development and installation of a new generation of Cockpit Voice Recorders (CVRs) which may utilize solid state memory and employ analog to digital conversions and related voice encoding techniques. The document supersedes the earlier ARINC Characteristic 557 and covers the overall Cockpit Voice Recorder system requirement but does take into consideration the detailed audio distributing system in the aircraft. The Cockpit Voice Recorder will be utilized to record aural communication between crew members and record the sounds of the acoustical environment of the cockpit. Attachment 1 shows a general system block diagram and the interfaces to the Cockpit Voice Recorder. The document provides specific guidance for the installation and for information to ensure customer controlled interchangeability of the equipment in a standard aircraft installation. Further it assists in the functional verification and retrieval of the recorded information.

1.2 Basic Principles

The objective of this Characteristic is primarily to describe equipment and installation standards capable of meeting the mandatory recording requirement. Further considerations are given to the crash survival requirements and methods for system evaluation and information retrieval. This document makes provisions for a combination voice and data recorder, digital communication message recording and the operation with an optional external Recorder Independent Power Supply (RIPS).

1.2.1 Relationship to ARINC Characteristic 557

ARINC Characteristic 557 on Airborne Voice Recorders (1964) describes equipment and installation standards for the earlier Cockpit Voice Recorder (CVR). ARINC Characteristic 557 was based on analog technology in the voice recording process. Both system characteristics define basically the same CVR recording technique. The CVR system of ARINC Characteristic 757 is interchangeable with the CVR system of ARINC Characteristic 557. The characteristics of ARINC 557 systems have been considered in the new interwiring. It is not the intention of this document to provide guidance on upgrading older equipment. While the systems may be interchangeable, the recorder and control unit should be treated as an entity and should not be separated.

1.2.2 Relationship to ARINC Characteristic 757A

ARINC Characteristic 757A covers implementation of a Cockpit Voice Recorder (CVR), configured for RIPS status monitoring and OMS reporting. In contrast, ARINC Characteristic 757 covers implementation of a Combined Voice and Flight Data Recorder (CVFDR)**, configured for RIPS status monitoring and optional OMS reporting.**

Also, in ARINC Characteristic 757A the AC and DC power returns are separated and isolated.

It is not intended that ARINC 757 recorders will be compatible with airplanes configured for ARINC 757A recorders.

1.2.3 Relationship to ARINC Characteristic 747

ARINC Characteristic 747 defines the Flight Data Recorder (FDR). For more details of the data recording provisions, see ARINC Characteristic 747.

1.2.4 Relationship to ARINC Characteristic 777

ARINC Characteristic 777 includes provisions and considerations for interfacing the recorder with an external Recorder Independent Power Supply (RIPS). This document also describes optional inclusion of the RIPS functionality within the recorder. For more details of the RIPS requirements, see ARINC Characteristic 777.

1.2.5 Relationship to ARINC Specification 429

Digital interface signals to the Onboard Maintenance System (OMS) **may be provided per** ~~have been considered for~~ ARINC Specification 429**. The bit rate may be either** low-speed **or** ~~and~~ high-speed.

Digital interface signals from the source of Data Link messages are provided per ARINC Specification 429. Depending on the source, the bit rate may be either low-speed or high-speed. The file data transfer protocol used to deliver the data link messages may be either Williamsburg Version 1 or Version 3.

1.2.6 Other Documents

EUROCAE ED-112, Minimum Operational Performance Specification (MOPS) for Crash Protected Airborne Recorder Systems was developed by an international committee including many accident investigators. It is essentially an upgrade of the EUROCAE ED-55 and ED-56A MOPS. ED-112 addresses higher audio quality in Cockpit Voice Recorders with solid state memory and up to 2 hour recording time. It also specifies higher crash survival requirements and an extended fire test. The test procedures for crash survival testing are clarified to assure equal testing levels by different manufacturers. Recording quality on each of the four (4) separate audio channels is defined and performance during power interruption has been clarified.

1.3 Unit Description

The Cockpit Voice Recorder receives four (4) separate audio inputs, three (3) crew communication channels and one (1) area microphone input. The recorder processes and stores this information (data) in crash protected memory. The recording duration will be determined by market and regulatory requirements.

COMMENTARY

The word memory used in this section and through the remainder of the document is used to describe a nonvolatile storage medium into which information can be stored and held until some later time, and from which the entire original information can be retrieved.

1.3.1 Additional Features (Optional)

a. The Cockpit Voice Recorder may provide the capability to store digital data link communications during the recording period stipulated by regulatory requirements. An ARINC 429 input has been reserved for this interface. Refer to EUROCAE ED-93.

b. The recorder may provide an ARINC 429 interface for BITE information to the On-board Maintenance System (OMS).

c. The Cockpit Voice Recorder may provide the capability to record Universal Time Coordinated (UTC) from a suitable time source, via an ARINC 429 interface. The installation of a combined recorder as defined in Appendix D has the FDR functionality. Refer to EUROCAE ED-112.

d. The functionality of a RIPS, as described in ARINC Characteristic 777, may be integrated as part of the CVR (internal RIPS).

1.3.2 Data Compression

Data compression, if utilized to reduce the size of the memory, shall meet the regulatory requirements.

COMMENTARY

EUROCAE ED-112 addresses audio quality in detail.

1.4 Reliability

The operational use of the CVR demands the utmost attention to the need for reliability in all phases of design, production, installation and operation of the equipment. Solid state memory elements inherently provide higher reliability over high maintenance electro-mechanical systems.

COMMENTARY

The designer may be surprised to find no elaborate requirements for reliability. The airlines are in a fortunate position in this regard because they have found the pressures of the marketplace exert a truly meaningful influence upon the design and production quality control necessary to achieve high equipment reliability. The key advantage enjoyed by the vast majority of airlines is the ability to purchase existing, fully operational equipment “off the shelf” after the product has established itself in the market.

1.5 Maintainability

A high degree of maintainability is expected by the user. Therefore, the system and unit design should provide for optimal maintainability.

As a minimum, the design should provide for replaceable, functional modules as far as practical with Built-in-Test Equipment (BITE) incorporated to detect and isolate failures.

COMMENTARY

If the recorder incorporates replaceable energy storage (e.g., batteries), it should be possible to replace the storage element without replacing or opening the recorder or causing significant return-to-service testing. The storage element and its interface should be designed so that it can be installed or removed while supplying power or being charged without damage to the equipment or hazard to personnel.

The recorder and its installation should be designed such that no damage to equipment or aircraft or harm to personnel will result from installing or removing the recorder while power is applied (hot-plugging). This is especially of concern in aircraft where an external RIPS is used. Provisions should include proper grounding of

equipment and unused connector pins, inrush-current limiting, and circuit protection to prevent damage from partial or intermittent engagement of the connector. Additional provisions should be included to minimize or eliminate sparking during engagement or disengagement of the connector. Appropriate warning placards should be visible to notify personnel of the possible presence of power.

1.6 Interchangeability

The basic CVR specified by this characteristic should be electrically and mechanically interchangeable among manufacturers.

COMMENTARY

Interchangeability between system components from various manufacturers is not intended. Since different audio encoding techniques may be used, manufacturer dependent interface will be needed for information retrieval from the memory. A standard digital or analog output from retrieval equipment is recommended providing thereby the interchangeability of equipment for voice and information analysis, data processing and storage.

Caution should be taken if using a recorder that includes an internal RIPS on aircraft that are equipped with an external RIPS. Means should be provided to easily disable the internal RIPS or to make its operation benign. See Appendix E herein for discussion of this issue.

1.7 Regulatory Approval

The Cockpit Voice Recorder should meet all applicable regulatory requirements. For those recorders employing digital encoding, a validation test of the recorded information may be required as part of the normal approval of the original equipment on the aircraft or by a supplemental type certification. The equipment manufacturer should refer to the applicable regulation. The installation manual should provide guidance on aircraft system testing to show compliance with the appropriate regulations.

2.0 INTERCHANGEABILITY STANDARDS

2.1 General

It is of prime importance that the Industry establishes specific form factors, mounting provisions, interwiring, inputs and output signal levels, and power supply standards for the Cockpit Voice Recorder. The establishment of aircraft installation standards cannot await the completion of the new equipment developments by the manufacturers. Because of the very extensive potential cost savings involved, advance planning on the part of the airline customers has always been necessary and is particularly so with the many problems of adding equipment to present aircraft and planning future installation.

Manufacturers should note that although ARINC Characteristic 757 does not preclude the use of standards different from those set forth herein, the practical problems of redesigning what will then be a standard aircraft installation to accommodate some special installation could very well make use of that other design prohibitively expensive for the potential customer. Therefore, manufacturers should recognize the practical advantage of developing equipment in accordance with the standard form factors and the standard interwiring shown in this document.

To ensure compatibility between specific recorders, control units, and microphones, these items should be sourced from the same manufacturer.

2.2 Form Factors, Connectors and Index Pin Coding

2.2.1 Cockpit Voice Recorder (CVR)

The Cockpit Voice Recorder shall comply with all requirements of ARINC Specification 404A for the 1/2 ATR short form factor.

2.2.2 Weight

The maximum weight of the Cockpit Voice Recorder should be 20 pounds.

2.2.3 Connectors

The Cockpit Voice Recorder shall be provided with a rear mounted single-shell 57-pin connector as defined in the latest revision of MIL-C-81659. Also, see ARINC Specification 404A for information and guidance. For the Cockpit Voice Recorder the equivalent of index pin coding is provided as an integral part of the single shell connector assembly as called out in Attachment 13. The connector shall be positioned as shown in Attachment 13. ARINC Specification 404A does not provide mounting standards for use of this type of connector or others in the series.

A front mounted connector may be provided for ground support functions and should include an information monitoring capability and verification of the BITE status. Voice and audio data stored in memory should not be available from this connector unless the unit is removed from the aircraft.

The keying configuration shall be as shown in Attachment 13. It is defined by ARINC Specification 404B, Appendix B. Position 01 is used for CVR or CVFDR configurations.

COMMENTARY

It has been recognized that at least one recorder manufacturer has elected to build an ARINC 757 recorder without audio recording. Therefore, non-standard keying has been used for this configuration

to preclude inadvertent installation of this type of recorder in a standard ARINC 757 installation.

2.2.4 Input and Output Signal Characteristics

All inputs and outputs are specified in Section 3 and are needed to ensure electrical interchangeability among ARINC 757 recorders built to the same supplement level.

2.3 Standard Interwiring

The standard interwiring of Attachment 2 and 3 is defined to ensure compatibility of the recorder in basic ARINC 757 Cockpit Voice Recorder systems. Provisions for optional interfaces are also included (Reference Section 1.3.1).

COMMENTARY

The interwiring configuration has been selected to permit backward compatibility with earlier ARINC 557 system configurations. In addition, the interwiring assignments are arranged to provide interference-free expansion to a full ARINC 757 configuration. Inadvertent installation of an ARINC 557 recorder into an ARINC 757 installation should cause no damage, although the recorder may not operate and equipment failure will be indicated via the CVR Fault (pin 23). The Test Indicator (pins 15 and 16) may not indicate fault.

An ARINC 757A recorder is incompatible with an ARINC 757 configured aircraft. The connectors are keyed differently to prevent installation of an incompatible recorder.

Wires should be routed for maximum survivability.

2.3.1 Wire Size

The equipment design should be such that currents in all interconnecting and power leads are less than 5 amps.

The equipment design should be such that for all interwiring with the exception of the specific wires exempted, cable runs up to 50 feet using wire no larger than No. 22 gauge will provide satisfactory operation of the equipment.

COMMENTARY

Suppliers should note that airframe manufacturers have planned to make use of wiring that allows correct operation of all CVR functions. The industry has generally preferred a minimum copper wire size of No. 22, but will support No. 24 gauge wire in those aircraft installations where special consideration is given to the manner of installation, the type of insulation used, and where the resistance of the wires actually employed is kept within the total allowable resistance authorized by the above specified limit of 50 feet (or 100 feet on some wires) of No. 22 gauge wire.

2.3.2 Shielding or Special Cabling

The standard interwiring of Attachment 2 and 3 specify certain shielded, twisted, or both twisted and shielded cabling which are expected to be provided in the standard aircraft installation. The equipment design should not require any shielded wire, specially twisted cables or other special installation treatment except as specifically shown in the interwiring diagram.

2.3.3 Specified Function Wires

Specified Function Wires are those wires that have designated and specific function labels assigned in the standard interwiring diagram. Examples include power circuits, common ground, standard inputs, and standardized instrumentation functions. Specified Function Wires shall not be used for other purposes.

The standard interwiring diagram designates the functions of specific wires or specific pins on the connectors. Wires without a designated function may be used in different ways by different equipment manufacturers provided that the wires do not require any special shielding, special size, or other special treatment which is not called out in Attachments 2 and 3, Standard Interwiring.

The important consideration is that the purchaser of the equipment and the airframe manufacturer planning an aircraft installation of the equipment should know the exact wiring required in an aircraft to permit any manufacturer's equipment to operate satisfactorily.

2.4 Primary Power Input

The equipment shall be designed to **operate with input power of** ~~utilize~~ 115 Vac 400 Hz single phase **and 28 Vdc** per the following:

ARINC Report 609: *Design Guidance for Aircraft Electrical Power Systems*

ARINC Report 607: *Design Guidance for Avionic Equipment*

Only one source of power is required in any aircraft installation.

~~The aircraft power supply characteristics, utilization equipment designs limitations and general guidance material are shown therein.~~

~~The 28 Vdc power input shall be provided as an alternate power source.~~

In installations where the 10 minute continuation of recording requirement is satisfied using an external Recorder Independent Power Supply (RIPS) and the aircraft uses AC power, the recorder may be presented with AC power, DC power or both. Failure of one part of the recorder power supply shall not affect operation of the other. Detailed guidance on primary power input can be found in EUROCAE ED-112.

COMMENTARY

The power that may be consumed by the recorder is limited by the capacity of the RIPS. See ARINC Characteristic 777 for this limit. In installations with an internal RIPS, consideration should be given to limiting instantaneous power consumption during system power-up, since the combination of recorder inrush current and the storage recharge may overload the supply circuits.

The use of power interlocks to meet regulatory requirements may complicate implementation of a RIPS capability. Refer to Appendix E herein for further details.

2.5 Environmental Specification

The equipment should be designed to meet the environmental minimum performance specifications as agreed upon by the applicable certification authority. DO-160, ED-112, TSO-C123, TSO-C124 and TSO-C177 provide further guidance.

COMMENTARY

An avionics manufacturer should survey the specifications presently in use by the airframe manufacturer and should be aware that the requirements of airframe manufacturers may differ from RTCA DO-160.

2.6 Software Design Guidance

Cockpit Voice Recorder equipment manufacturers should use RTCA DO-178/ EUROCAE ED-12: Software Considerations in Airborne Systems and Equipment Certification and EUROCAE ED-112 for guidance during the design process.

2.7 Hardware Design Guidance

Cockpit Voice Recorder equipment manufacturers should use RTCA DO-254/ EUROCAE ED-80: Design Assurance Guidance for Airborne Electronic Hardware for guidance during the design process.

3.0 RECORDER DESIGN

3.1 General

The Cockpit Voice Recorder shall be designed to receive, process, record, and preserve audio signals from four sources. It may also be used to record flight data and data link communication.

3.1.1 Recording Technology

No constraint is intended on the memory technology that is utilized. The method of recording and storage will be determined by market and regulatory requirements. Retrieval of the data shall not alter or rewrite the data in the storage medium. Data compression can be utilized to reduce the memory size but shall be reversible and shall meet the requirements specified by EUROCAE ED-112.

3.1.2 Audio Erase

A provision for erasing or disallowing normal playback operations of the recorded audio signal should be provided. Proper interlock will be required such that the erase function can only be activated at the conclusion of the flight. See Attachment 7. Inadvertent activation should be minimized. More detailed guidance on interlocks can be found in ED-112.

COMMENTARY

In addition to other interlocks, one method to help minimize inadvertent activation of this function is to require that the Erase button be held for a period of time before erase actually commences.

3.1.3 Audio Levels

Area mic performance shall be as defined in ED-112 and the corresponding voltage presented to the recorder is defined by the recorder manufacturer. Input levels for crew audio shall be as defined in Attachment 6, Note 11.

3.2 Information Recovery

The information recovery equipment or interface unit is outside the scope of this Characteristic. However, the interface is part of the system design consideration. Means should be provided to enable the aircraft crew to concurrently monitor the information which is being recorded. The means for copying the CVR audio information, which has been stored in the memory, should require that the recorder be removed from the aircraft. A recorder front panel connector or pins on the rear connector may be used for monitoring recorded information. The primary interface for information recovery is to be specified by the equipment manufacturer.

3.3 Aircraft Configuration Interface

A Record Enable interface is provided in the aircraft connector (jumper pin 7 to 8). When the recorder is removed from the aircraft (pins 7 and 8 not jumpered) and power is applied, the recorder shall not record or erase previously stored information. When installed on the aircraft (pins 7 and 8 jumpered), the recorder shall inhibit audio replay of only crew and area mic audio.

COMMENTARY

If Record Enable (pins 7 and 8) is controlled with logic, there is the possibility that audio replay could occur when pins 7 and 8 are open.

In this configuration, additional steps should be taken to prevent audio replay on the aircraft.

Two pins should be used to select between FDR data rates of 64 (or 1024), 128, 256 or 512 words per second. If the CVFDR senses a mismatch between the configuration pins and the detected data rate, the CVFDR should attempt to synchronize with the input signal and record the data.

3.4 Power Interruptions

Performance during power interruptions shall be as defined in ED-112.

3.5 Failure Warning and Functional Test

Basic industry philosophy and requirements applicable to failure monitoring and warning systems are set forth in ARINC Reports 604 and 624. In particular, the reader is referred to ARINC Report 624 for a description of the relationship between "Minimum Requirements" and "Customer Needs" as used in this document.

3.5.1 Minimum Requirements

Means shall be provided in the equipment for preflight dispatch tests. As a minimum, such tests should determine that information is being stored in the recording medium.

Correct operational status shall be indicated by a standard ground signal on CVR Fault, FDR Fault, and Data Link Fault, as defined in Sections 3.5.2, 3.5.3 and 3.5.7. These signals shall be capable of controlling a lamp or relay load within the range of 1 to 100 milliamperes where the power is derived from a standard +28 Vdc aircraft electrical system including the voltage transients described in ARINC Report 609. In addition, FDR Status, defined in Section 3.5.4 and Indicator Power, defined in Section 3.5.5, may be used with FDR Maintenance defined in Section 3.5.6 to determine operational status in configurations that are compatible with ARINC Characteristics 573, 717 and 747.

COMMENTARY

The FDR Status, FDR Maintenance and Indicator Power Input are optional in equipment that includes the FDR function.

The "Standard Ground" signal may be generated by either a solid state or mechanical type switch. In either case, a "contact potential" or residual voltage of 3.5 volts or less shall represent the "grounded" condition with 100 mA current. For additional information, refer to ARINC Specification 720.

COMMENTARY

Detailed requirements for built-in test equipment are not given since the pressures of the marketplace exert a compelling necessity for the designer to ensure a high maintainability for the equipment. It is expected therefore, that BITE equipment will detect at least 95% of failures and assign these to the correct LRU with a probability of at least 95%.

When a switch manufacturer specifies a steady state lamp load rating of 0.2 amps, it is implied that the switch is designed to handle the high lamp load inrush currents resulting from the low resistance of the filament when the lamp is cold. An estimate of the inrush current is widely accepted to be 10 times the steady state lamp load.

Therefore, a switch intended to carry a 0.2 amp lamp load must be rated for at least 2 amps ~~0.2 amps~~.

3.5.2 CVR Fault (Pin 23)

The CVR monitoring circuitry shall provide a CVR fault signal as defined in Attachment 20.

COMMENTARY

In CVR installations where an internal independent power source is utilized to fulfill the requirement for 10 minute sustained recording, the CVR monitoring circuitry should be capable of monitoring and reporting the health of the internal independent power source.

3.5.3 FDR Fault (Pin 24)

The FDR monitoring circuitry shall provide an FDR fault signal as defined in Attachment 20. If an FDR function is not present, this pin shall be left open.

3.5.4 FDR Status (Pin 36) (Equivalent of ARINC 747 Pin 21) (Optional)

If compatibility with ARINC Characteristics 717 and 747 is required, in addition to the FDR fault signal defined in 3.5.3, the recorder shall provide an FDR status signal as described in Attachment 20.

COMMENTARY

If FDR Status is indicated and FDR Maintenance is not indicated, configuration compatibility should be checked first.

Non-operational status should be indicated by the change from the voltage applied at Indicator Power (pin 4) to a “Standard Ground” on the “FDR Status” output. The “Standard Ground” should be capable of controlling a lamp or relay load within the range of 10 to 100 milliamperes where the power is derived from a standard +28 Vdc aircraft electrical system including the voltage transients described in ARINC Report 609, however, the +28 Vdc may be reduced to approximately 12 Vdc where the power is supplied from a “Master” dimmable lighting bus.

3.5.5 Indicator Power Input (Pin 4) (Equivalent of ARINC 747 Pin 23) (Optional)

If compatibility with ARINC Characteristics 717 and 747 is required, the recorder shall provide an input pin as defined in ARINC Characteristics 717 and 747 to supply the voltage used to indicate Operational State (no faults) on the FDR Status output (pin 36). Refer to Attachment 20.

Open circuits or voltages up to 32 Vdc or 32 Vac (peak) shall be accommodated without damage to the recorder or attenuation of the signal. When Operational State is to be indicated, Indicator Power shall be directly connected to FDR Status.

COMMENTARY

This signal permits flexibility in implementation. It can be used to detect removal of the equipment, absence of power, or any detected faults, and to interface with several different types of indication systems (fault flags, lamps, OMS, etc.)

Aircraft wiring could provide voltage to light a lamp independent of the recorder power input. A master dimming circuit could control this voltage.

Alternatively, Indicator Power could be left unconnected, resulting in FDR Status functioning as an Open/Ground output discrete.

See ARINC Characteristic 717 for guidance on possible aircraft implementations.

3.5.6 FDR Maintenance (Pin 46) (Equivalent of ARINC 747 Pin 22) (Optional)

If compatibility with ARINC Characteristics 717 and 747 is required, in addition to the FDR fault signal defined in 3.5.3, the recorder shall provide an FDR maintenance signal as described in Attachment 20.

3.5.7 Data Link Fault (Pin 31)

The data link monitoring circuitry shall provide a Data Link Fault signal as defined in Attachment 20. If a data link function is not present, this pin shall be left open.

3.5.8 OMS Compatibility (Optional)

The Cockpit Voice Recorder, as an option, should provide the necessary ARINC 429 input/output to interface with an On-board Maintenance System (OMS). When implemented, this interface shall be used to transfer the data as defined in Section 4.2.1.

3.6 Recording Duration

The Cockpit Voice Recorder shall have a recording duration as specified by the applicable regulation and operating requirements for an aircraft of a certain size or weight and operating classification.

The Flight Data Recorder, if implemented, shall have a recording duration as specified by the applicable regulation. If data compression is employed to conserve memory, a validation of the recording duration may be required with the data format of the specific aircraft to satisfy the applicable regulation. See ED-112 for further details.

Some regulations restrict FDR recording periods. Pin 44 (FDR Inhibit) is provided to inhibit recording while grounded and to enable recording when open. FDR interlock provisions are defined in Section 2.5.2 of ARINC Characteristic 717.

3.7 Crash Protection

The recorder shall meet the survival requirements of ED-112 with its defined test procedures and test sequence. ED-112 also provides guidance on the location of the recorder installation.

COMMENTARY

Most regulatory agencies require that an approved underwater locator device be securely fastened to the crash survival portion of the recorder. Consideration should be given to ease of access for maintenance purposes.

3.8 Time Correlation

Accident investigators have experienced difficulties in establishing a time correlation between the Cockpit Voice Recorder and the Flight Data Recorder information. ICAO recommends that a means for accurate time correlation should be provided between the Cockpit Voice Recorder and the Flight Data Recorder.

In the case of a CVR-only implementation, one approach for CVR/FDR time synchronization is for the CVR to receive Universal Time Coordinated (UTC) directly from the captain's clock via a low-speed ARINC 429 channel. The label of this clock is 125 for BCD and 150 for the Binary version.

COMMENTARY

When recording Digital Communications Data Link, airplane system designers should take measures to ensure that the time stamping contained in recorded data link messages addressed in ARINC Specification 619 can be correlated with the source for time input to the CVR/FDR input (UTC IN (429)).

In the case of a combined recorder, the CVR and FDR data should be recorded in such a way that time correlation is preserved for playback. See ED-112 for further details.

Some aircraft are not equipped with ARINC Standard clocks. In these aircraft, the FDAU (or ARINC 542A Digital Flight Data Recorder) provides a time marker as a tone burst output, using Frequency Shift Key (FSK) modulation. The frequencies used are 3607 Hz (±30 Hz) and 4193 Hz (±30 Hz), which are outside the required audio pass-band. This tone is recorded on one of the CVR channels (3rd crew member/PA). Both 12-bit and 32-bit codes have been used. As an option, the CVR should be capable of recording these tone bursts. If new recorders employ sharp filters at the audio pass-band and they are unusable to record these tones, alternate methods may need to be used to meet these requirements.

COMMENTARY

In some existing CAA installations, the aircraft audio inputs are interchanged whereby the Pilot is wired to CHANNEL NO. 1 EXTRA and the 3rd Crew or PA (or TIME MARKER TONE) is wired to CHANNEL NO. 3 PILOT. This type of channel input wiring is applied for certain tape based CVRs to assure that the two innermost tape tracks are used for the most important channels. With solid state recorders this condition does not apply and either input wiring is acceptable.

Similarly, Helicopter Rotor Speed was often recorded on frequencies out of the band pass. Data within the recorder band pass is required for this information to be recorded. Consideration needs to be given to this fact when interchanging one recorder type with the other.

3.9 Data Link Communications (Optional)

Regulatory requirements define for the Cockpit Voice Recorder to record: "Voice Communications transmitted from or received in the airplane by radio." In some installations, communication with Air Traffic Control will encompass digital technologies.

When implemented, Data Link messages will be provided to the CVR on an ARINC 429 data bus. A pair of input pins (Data Link In pins 33 and 34) is reserved for an ARINC 429 input bus. Data received on this bus may be either low-speed or high-speed and either Williamsburg V1 or V3 protocol. The recorder shall automatically detect and adapt to the actual bus speed and protocol.

3.0 RECORDER DESIGN

The specific message protocol is defined in Section 6.0 of **ARINC Specification 619:** *ACARS Protocols for Avionic End Systems.*

The recorder **shall** ~~should~~ record the data link source status data, identified by ARINC 429 labels 270 and 276, received at a rate of once per second. This data may either be recorded continuously or when the data changes, at the manufacturer's discretion.

The recorder shall provide sufficient recording capacity to record the standard messages as defined in EUROCAE ED-112.

The recorder shall meet the ED-112 requirements for time correlation of these digital messages relative to voice information.

Internal BITE associated with this input and storage of digital communication (Data Link) information shall be reported via the Data Link Fault output (pin 31) and via the Data Link Recording bit (bit 16) of the Recorder Status Word (label 350) of the OMS output as defined in Attachment 19.

When the Data Link Valid input (pin 56) is at Standard Ground, the recorder shall expect digital communications recording and shall validate bus operation via the presence of ARINC 429 label 270 (heartbeat) at a time interval of once per second. Absence of this label for three consecutive samples shall be reported via the Data Link Fault output (pin 31) and, if the OMS function is provided, via the Data Link Interface Status bit (bit 16) of the Recorder Status Word of the OMS output (pins 50 and 51). If the Data Link Valid is open, the recorder shall not report failures of the Data Link interface heartbeat. When Williamsburg V1 is used as the protocol, pins 50 and 51 will be shared with the OMS output for handshakes back to the CMU using label 304.

COMMENTARY

Optionally, pins 50 and 51 may be connected to the CMU even when Williamsburg V3 is used. This would allow the CMU to monitor the CVR 429 status word (label 350). There may be future enhancements that would make use of these wires, such as downloading data.

Whether the Data Link Valid signal is open or grounded, the recorder should continue to record Data Link communications normally.

For dual recorder systems one common bus will provide messages to both recorders (Data Link In pins 33 and 34). For Williamsburg V3 systems the same message will be sent once with the ARINC 429 label 157. If the messages are sent using Williamsburg V3, then both CVR #1 and CVR #2 should accept and record those messages.

For Williamsburg V1 systems, messages will be sent from the data link source to both CVRs using one common bus (pins 33 and 34). The label for the second recorder will be identified by ARINC 429 label 156. One bus from each CVR will connect back to the data link source for the handshakes. These buses will be shared with the OMS Out of each recorder (pins 50 and 51). A CVR Ident Pin Program (pin 42) will be used to identify the recorders as #1 (label 157) or #2 (label 156). An "open" indicates CVR #1. A "ground" indicates CVR #2. CVR #1 should record messages with label 157 and CVR #2 should record messages with label 156.

See Appendix F for installation guidance.

3.10 Combination Voice and Flight Data Recorder

Electrical interface and connector pin selection for ARINC Characteristic 757 allows for a Combination Voice and Flight Data Recorder. Data input should be in a serial format, as defined in ARINC Characteristics 573, 717 or 747. See ED-112 for further details.

3.11 Recording Start/Stop

Within the installation, a means should be provided to terminate audio and data link recording after the aircraft is no longer moving under its own power, or after an accident. The Stop CVR Recording pin (Pin 10) is provided for this function. The recorder shall stop recording 10 minutes (+0/-60 seconds) after a ground is applied to this pin. The ground must be held for the duration of the 10 minute period for the recorder to stop recording. Upon removal of the ground, the recorder shall resume recording within 250 milliseconds if power is available. The timer shall reset each time the ground is removed. See ED-112 for further details.

For installations where recording must be sustained for 10 minutes after loss of input power, the recording will continue until 10 minutes after a ground is applied to this pin or aircraft power is removed, whichever occurs first. In any case, recording will cease after 10 minutes. For installations where a Time Delay Relay is used instead of the input discrete to stop recording, additional provisions should be made as described in Section 3.15 to prevent cascading of the 10-minute delays.

COMMENTARY

For audio, the stop recording logic will be provided by the airframe as required to meet CVR recording regulations. Care should be taken to ensure that the stop recording logic for Pin 10 does not activate unintentionally and cause premature cessation of recording.

Additionally, several methods of ceasing CVR recording have been implemented by aircraft manufacturers that do not use Pin 10, such as controlling the Record Enable loopback (Pins 7 and 8) with logic or implementing a power interlock to control the recorder. In cases such as these, it is extremely important that system designers ensure that the logic implemented is robust enough to not induce a cessation of recording in a situation when the RIPS should keep the recorder operational because these methods bypass the protection provided with the Pin 10 functionality.

Within the installation, a means should also be provided to terminate FDR recording (if applicable), after the aircraft is no longer moving under its own power, or after an accident. The FDR Inhibit pin (Pin 44) is provided for this function. The recorder shall stop recording FDR information whenever a ground is applied to this pin. The logic will be provided by the airframe manufacturer and may be based on the shutdown of all engines. Information recorded prior to the cessation of recording should be preserved. Removal of the ground logic shall cause the FDR to begin recording within 500 milliseconds. See ED-112 for further details.

COMMENTARY

For data, the stop recording logic will be provided by the airframe as required to meet recording regulations. Care should be taken to

ensure that the stop recording logic for Pin 44 does not activate unintentionally and cause premature cessation of flight data recording.

3.12 Cockpit Microphone Installation

Experience with CVR installations has shown that the placement of the area microphone in the cockpit is of vital importance for obtaining acceptable voice quality and reduced levels of noise. ED-112 provides further details. Appendices A and B to this document provide guidance on microphone location.

Certain regulatory agencies require that flight crew speech be recorded directly from the boom or mask microphones used by each crew member, even when the crew member is not using the key switch. This method assures better voice quality than achievable from the area microphone. This requirement is implemented in the aircraft Audio/Interphone system.

3.13 Aircraft Installation and Functional Verification

The Installation and Operating Instructions of the equipment manufacturer is the main guidance document. It contains the Environmental Qualification Form (EQF) which lists the categories in the various RTCA DO-160 sections to which the equipment has been certified. A functional verification is required which needs to include verification of all the audio signal inputs and warning sound signals. Periodic inspection and maintenance requirements are also detailed in the manufacturer's installation manuals and should be followed. Additional guidance can be found in the RTCA DO-214: Audio Systems Characteristics and Minimum Operational Performance Standards for Aircraft Audio Systems and Equipment. See ED-112 for further details.

3.14 Rotor Speed (Optional)

As an option, a set of pins for direct rotor speed tachometer input has been reserved. ARINC Characteristic 573 defines the characteristics of the signal.

3.15 Recorder Independent Power Supply (RIPS)

Regulations require some aircraft to be fitted with CVR installations that are able to sustain recording for 10 minutes following loss of recorder power from the aircraft. One means of accomplishing this is through implementation of a Recorder Independent Power Supply (RIPS) that is capable of sustaining CVR power needs for at least 10 minutes. The RIPS function may be integrated as part of the CVR (internal RIPS), or it may be an external energy source, which is located near the CVR (external RIPS). An internal RIPS shall provide the functionality described in ARINC Characteristic 777 and, by definition, does not interconnect with the CVR through the CVR rear connector. Refer to Appendix E.

COMMENTARY

Due to the complexity of ensuring that multiple RIPSs do not extend the shutdown time beyond 10 minutes, installing both an internal and an external RIPS for the same CVR is strongly discouraged.

CVRs fitted with an internal RIPS should be identified with a part number that is different from a CVR without an internal RIPS. This will help ensure that an internal RIPS is not installed into an aircraft which already has an external RIPS.

4.0 PROVISION FOR TEST

4.1 Built-In Test Equipment

The recorder should, as an option, contain Built-In Test Equipment (BITE) capability in accordance with **ARINC Report 624:** *Design Guidance for Onboard Maintenance System (OMS).*

The OMS described incorporates the traditional areas of failure monitoring and fault detection, BITE, BITE access, and an Airplane Condition Monitoring System (ACMS), formerly known as Aircraft Integrated Data System (AIDS). It further describes the capability to provide On-board Maintenance Documentation (OMD) and the need for total integration of these functions. It describes the needs for all elements of the OMS, including a Central Maintenance Computer (or CMC function) and all the member systems which interface with it.

Airframe manufacturers and equipment designers are encouraged to take advantage of this guidance information, beginning with the earliest design phases of new equipment. Users may also find this information helpful in standardizing maintenance planning and procedures and in securing appropriate recognition for such procedures from the regulatory agencies. It is particularly important that the guidelines set forth in ARINC Report 624 are considered in terms of the overall perspective of the users' needs, rather than some more limited objective.

4.2 Fault Reporting

4.2.1 OMS Compatibility (Optional)

When implemented, the recorder **shall** ~~should~~ provide the necessary BITE circuits including an ARINC 429 transmitter and receiver to interface with an OMS as defined by ARINC Report 604 and ARINC Report 624. The recorder **shall** ~~should~~ transmit the status at a nominal 1 Hz rate. The status **shall** ~~should~~ be transmitted on Label 350 per ARINC 429 using the structure shown in Attachment 19. Label 354 is reserved for manufacturer-specific part/serial number reporting. The CMC bus status bit **shall** ~~should~~ be set when Label 227 is absent for three consecutive samples and/or when there is a parity error for three consecutive samples.

For faults detected during ground test, the recorder logic **shall** ~~should~~ hold the fault for a minimum of 30 seconds after SSM is set to normal.

The recorder **shall** ~~should~~ accept a test command word on Label 227, per ARINC Specification 429, using the structure shown in Attachment 19.

The recorder **shall** ~~should~~ acknowledge the receipt of a valid ground test command word by setting the "Command Acknowledge," Bit 29, to 1 and by setting its SSM bits to "TEST." The Command Acknowledge bit and the SSM of TEST **shall** ~~should~~ be held a minimum of 5 seconds or until the test is completed, whichever is longer.

The recorder **shall** ~~should~~ set the "Test Inhibit" digital discrete, Bit 28, whenever the recorder has inhibited the initiation of the test. This discrete **shall** ~~will~~ remain set for as long as the test is inhibited.

4.0 PROVISION FOR TEST

COMMENTARY

New equipment designs should be produced in accordance with ARINC Report 624. ARINC Report 624 supersedes ARINC Report 604. The optional use of ARINC Report 604 is to provide for retrofit installations where an OMS is not present and the equipment will need to interact with an ARINC 604 Centralized Fault Display System (CFDS).

4.2.2 Monitor Memory Input

Fault data and relevant information should be inserted and held in a fault memory within the recorder. The presence of an internal fault, when detected, should be entered into the memory. If available to the recorder, other useful data such as time, flight leg, etc. should also be recorded. These parameters are available on the CFDS input data bus.

4.3 Automatic Test Equipment

To enable Automatic Test Equipment (ATE) to be used in the bench maintenance, internal circuit functions not available at the unit service connector and considered by the equipment manufacturer necessary for automatic test purposes may be brought to pins on an auxiliary connector of a type selected by the equipment manufacturer. This connector should be fitted with only that number of contacts needed to support the ATE functions. The connector should be provided with a protective cover suitable to protect these contacts from damage, contamination, etc., while the unit is installed in the aircraft. The manufacturer should observe ARINC Specification 600 standards for unit projections, etc., when choosing the location for this auxiliary connector.

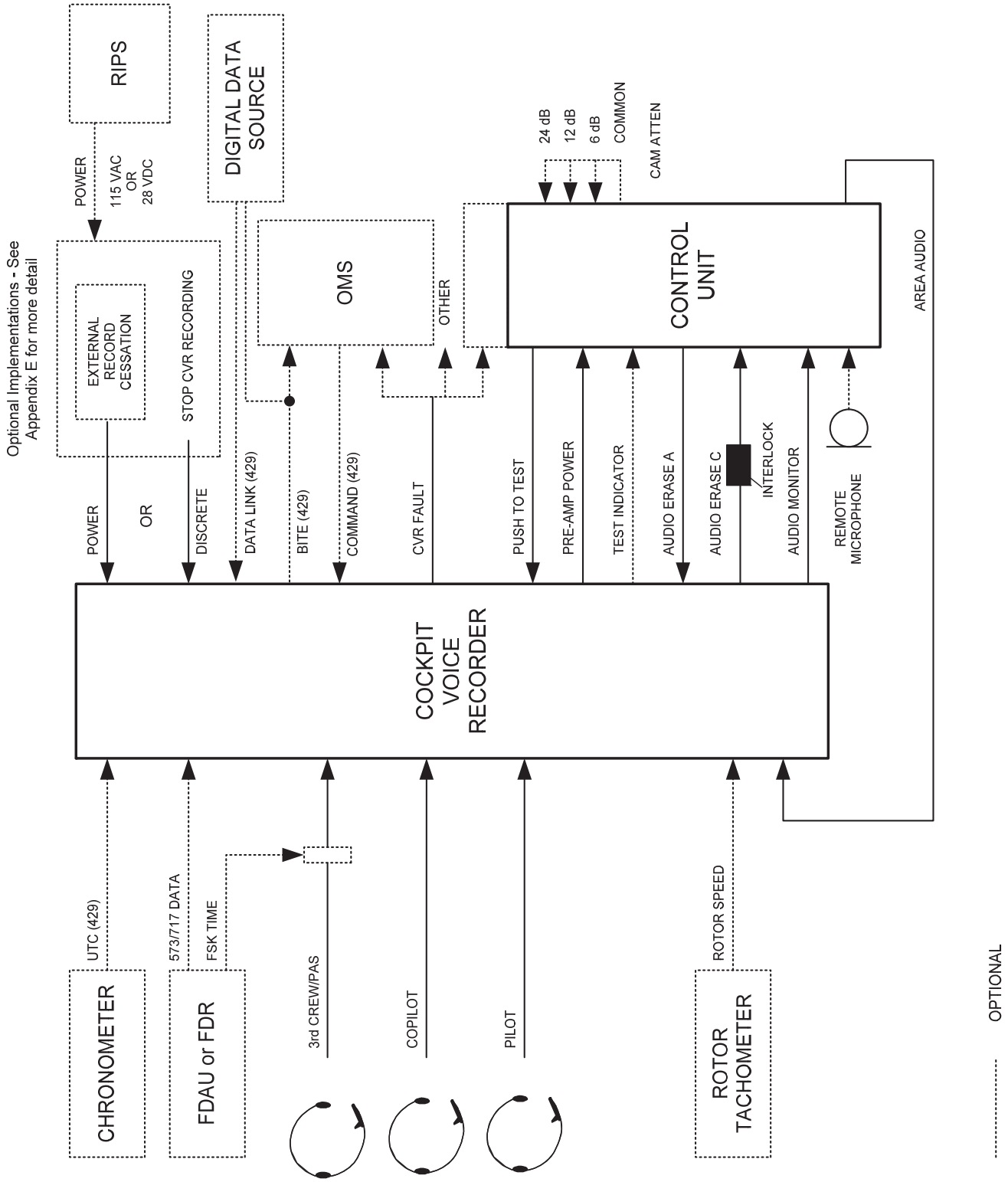
4.3.1 ATE Testing

The recorder should be ATE testable when removed from the aircraft. The industry suggests a test program written using the ATLAS language elements of **ARINC Specification 626:** *Standard ATLAS for Modular Tes*t developed in accordance with **ARINC Report 627:** *Programmers Guide for SMART™ System Using ARINC 626 ATLAS.*

The ATLAS test procedure should be designed to work on a test system built to comply with **ARINC Specification 608A:** *Design Guidance for Avionics Test Equipment.*

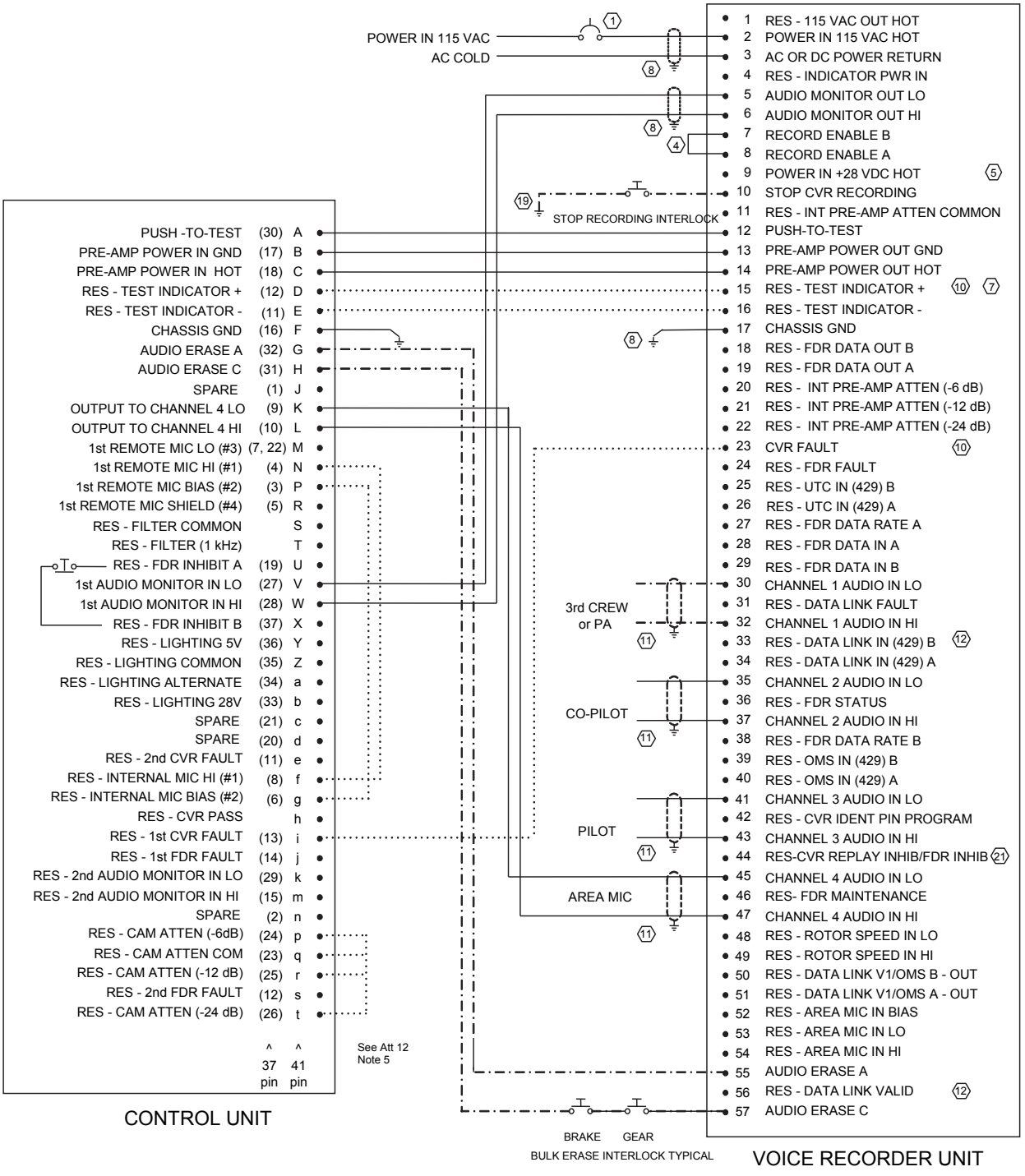
ATTACHMENT 1
SYSTEM BLOCK DIAGRAM

ATTACHMENT 1 SYSTEM BLOCK DIAGRAM



ATTACHMENT 2
CVR INTERWIRING DIAGRAM WITH INTERNAL MICROPHONE
(AC POWER SHOWN)

ATTACHMENT 2 CVR INTERWIRING DIAGRAM WITH INTERNAL MICROPHONE (AC POWER SHOWN)



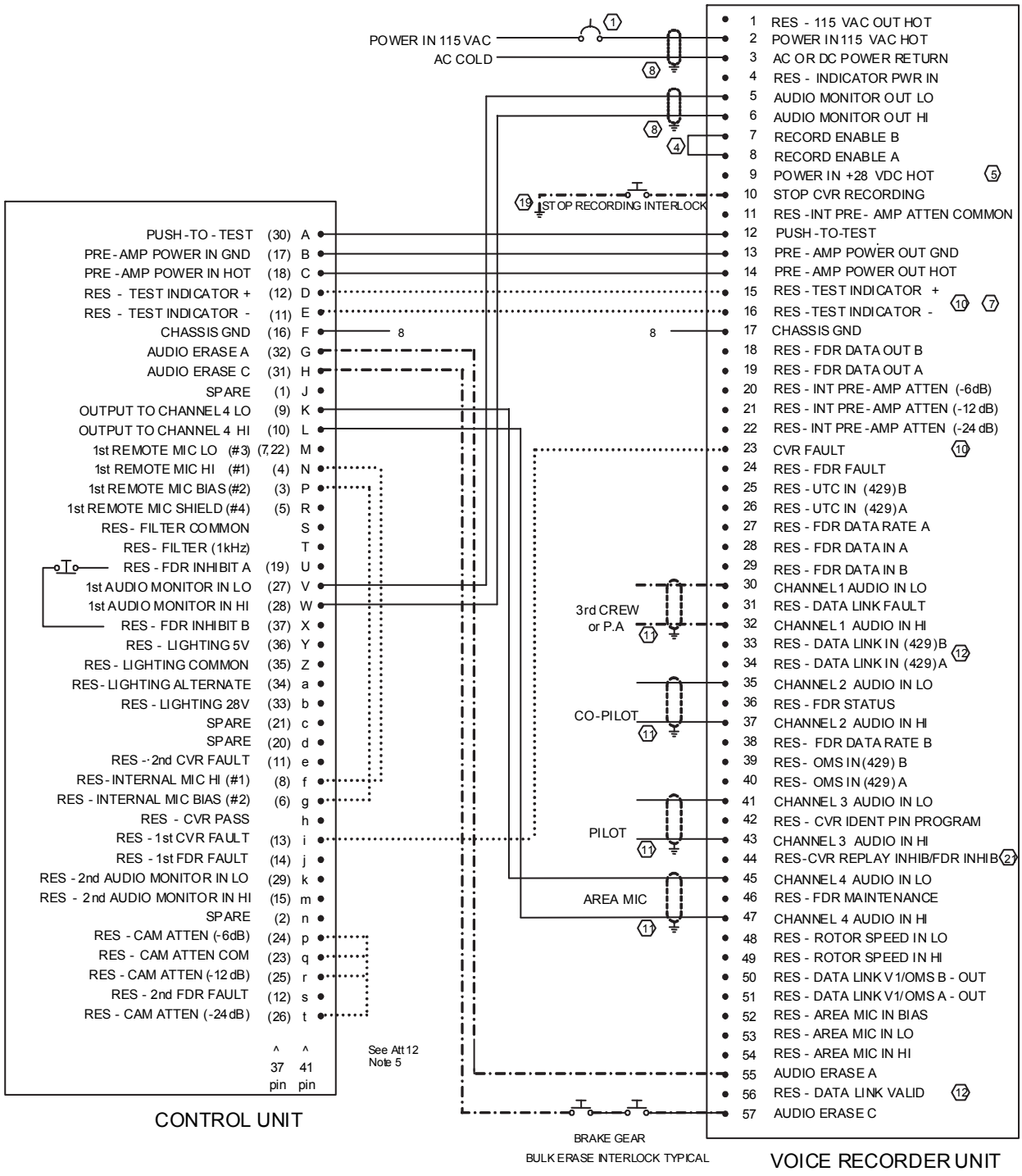
Denotes Minimum Wiring
Denotes Optional Wiring
Denotes Alternate Wiring

AIRCRAFT WIRING ALTERNATES	
POWER SUPPLY	115 VAC or 28 VDC or BOTH
COCKPIT AREA MICROPHONE	REMOTE or INTERNAL
FAULT INDICATION	TEST INDICATOR or CVR FAULT or BOTH
CAM ATTEN	AS REQUIRED FOR OPTIMUM PERFORMANCE

See Attachment 6 for notes indicated by ⬡

ATTACHMENT 3
CVR INTERWIRING DIAGRAM WITH REMOTE MICROPHONE
(DC POWER SHOWN)

ATTACHMENT 3 CVR INERWIRING DIAGRAM WITH REMOTE MICROPHONE (DC POWER SHOWN)



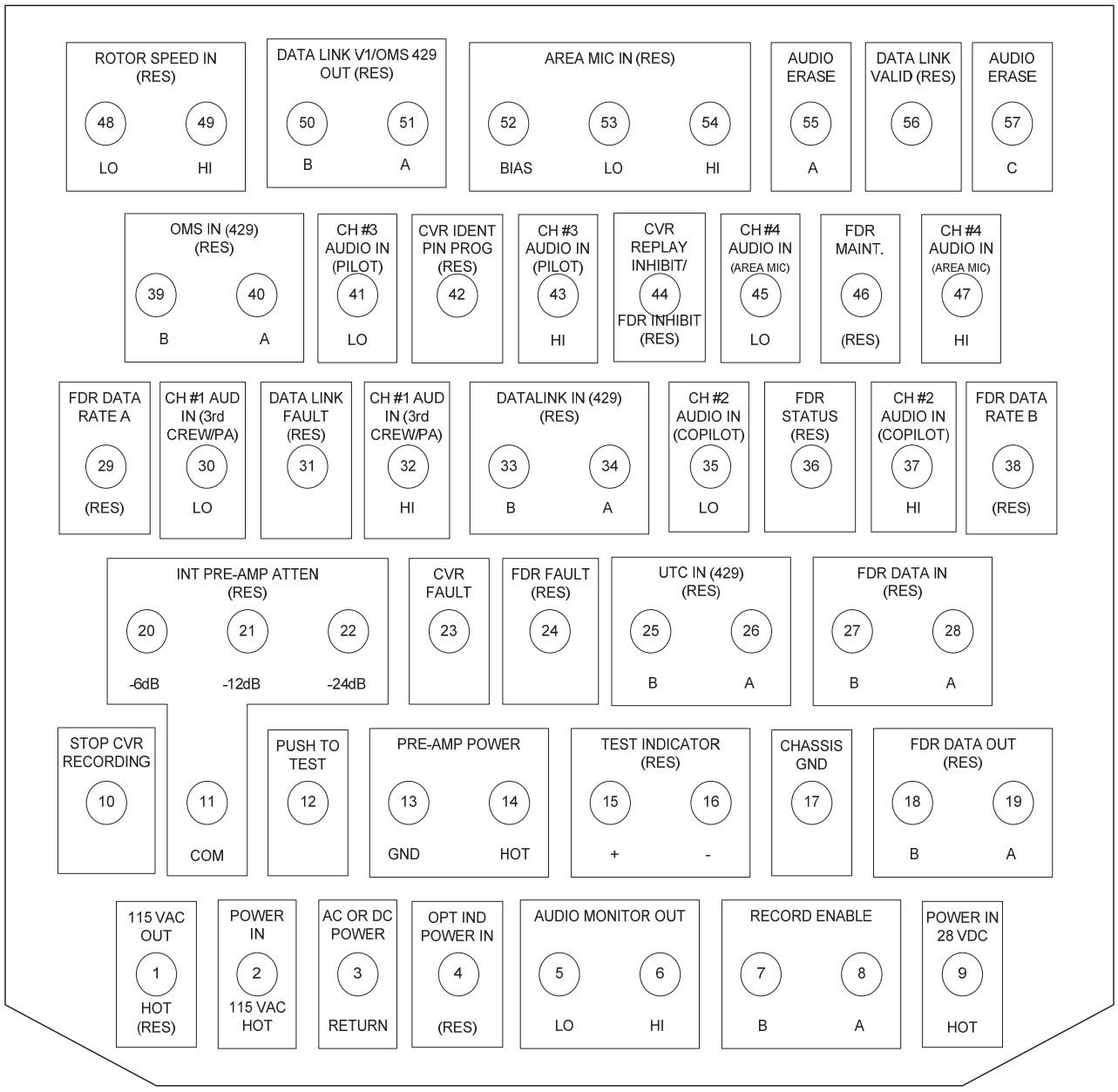
Denotes Minimum Wiring
Denotes Optional Wiring
Denotes Alternate Wiring

AIRCRAFT WIRING ALTERNATES	
POWER SUPPLY	115 VAC or 28VDC or BOTH
COCKPIT AREA MICROPHONE	REMOTE or INTERNAL
FAULT INDICATION	TEST INDICATOR or CVR FAULT or BOTH
CAM ATTEN	AS REQUIRED FOR OPTIMUM PERFORMANCE

See Attachment 6 for notes indicated by ⬡

ATTACHMENT 4
CVR CONNECTOR LAYOUT
TYPE 57 PIN

ATTACHMENT 4 CVR CONNECTOR LAYOPUT TYPE 57 PIN



Engaging Face View as Viewed from Rear of Equipment

Res = Reserved pin provides functions additional to minimum standard

ATTACHMENT 5
CVR STANDARD INTERWIRING PIN DESIGNATION

ATTACHMENT 5 CVR STANDARD INTERWIRING PIN DESIGNATION

FUNCTION	PIN	CVR	CVFDR	NOTES	REMARKS
RES - 115 VAC OUT HOT	1	O	O	5	JUMPER 1 TO 2 FOR ARINC 557 DC INPUT
POWER IN 115 VAC HOT	2	A	A	1	HEAVY GAUGE WIRE
AC or DC POWER RETURN	3	M	M	5	AC POWER LOW OR OPTIONAL DC RETURN
RES - INDICATOR POWER IN	4	O	O	22	
AUDIO MONITOR OUT LO	5	M	M	3	TO AUDIO MONITOR
AUDIO MONITOR OUT HI	6				
RECORD ENABLE B	7	M	M	4	JUMPER - RECORD ENABLE PIN 7 TO 8 IN ALL AIRCRAFT
RECORD ENABLE A	8				
POWER IN 28 VDC HOT	9	A	A	5	HEAVY GAUGE WIRE
STOP CVR RECORDING	10	M	M	19	GND = STOPS WITHIN 10 MIN
RES - INT PRE-AMP ATTEN COMMON	11	O	O	6	
PUSH-TO-TEST	12	M	M		GND = TEST
PRE-AMP POWER OUT GND	13	M	M		
PRE-AMP POWER OUT HOT	14				
RES - TEST INDICATOR +	15	O	O	7	ARINC 557 COMPATIBLE 1 mA
RES - TEST INDICATOR -	16				
CHASSIS GND	17	M	M	5 & 8	AUDIO GND AND DC RETURN
RES - FDR DATA OUT B	18	O	M	9	
RES - FDR DATA OUT A	19				
RES - INT PRE-AMP ATTEN (-6dB)	20	O	O	6	
RES - INT PRE-AMP ATTEN (-12 dB)	21				
RES - INT PRE-AMP ATTEN (-24dB)	22				
CVR FAULT	23	M	M	10	GND = GOOD CONTINUOUS TEST
RES - FDR FAULT	24	O	M	17	GND = GOOD CONTINUOUS TEST
RES - UTC IN (429) B	25	O	O	18	
RES - UTC IN (429) A	26				
RES - FDR DATA IN B	27	O	M	9	
RES - FDR DATA IN A	28				
RES - FDR DATA RATE A	29	O	M	20	
CHANNEL 1 AUDIO IN (3rd CREW OR EXTRA) LO	30	M	M	11	PILOT INPUT/TIME OR ROTOR SPEED
RES - DATA LINK FAULT	31	O	O		GND = GOOD
CHANNEL 1 AUDIO IN (3rd CREW OR EXTRA) HI	32	M	M	11	PILOT INPUT/TIME OR ROTOR SPEED
RES - DATA LINK IN B	33	O	O	12	
RES - DATA LINK IN A	34				
CHANNEL 2 AUDIO IN (CO-PILOT) LO	35	M	M	11	
RES - FDR STATUS	36	O	O	22	
CHANNEL 2 AUDIO IN (CO-PILOT) HI	37	M	M	11	
RES - FDR DATA RATE B	38	O	M	20	
RES - OMS IN (429) B	39	O	O	13	
RES - OMS IN (429) A	40				
CHANNEL 3 AUDIO IN (PILOT) LO	41	M	M	11	
RES - CVR IDENT PIN PROGRAM	42	O	O	23	GND = 2ND CVR
CHANNEL 3 AUDIO IN (PILOT) HI	43	M	M	11	
RES - CVR REPLAY INHIBIT/FDR INHIBIT	44	O	M	21	GND = INHIBIT
CHANNEL 4 AUDIO IN (AREA MICROPHONE) LO	45	M	M	11	
RES - FDR MAINTENANCE	46	O	O	22	
CHANNEL 4 AUDIO IN (AREA MICROPHONE) HI	47	M	M	11	
RES - ROTOR SPEED IN LO	48	O	O	14	
RES - ROTOR SPEED IN HI	49				
RES - DATA LINK V1/OMS (429) - OUT B	50	O	O	13	
RES - DATA LINK V1/OMS (429) - OUT A	51				
RES - AREA MIC IN BIAS	52	O	O	15	
RES - AREA MIC IN LO	53				
RES - AREA MIC IN HI	54				
AUDIO ERASE A	55	M	M	16	
RES - DATA LINK VALID	56	O	O	12	GND = REPORT DATA LINK FAILURE
AUDIO ERASE C (+SUPPLY)	57	M	M	16	TO AIRCRAFT INTERLOCK

M = Function is basic to the minimum definition for this standard.
O = Function is optional.
A = Alternate configurations

See Attachment 6 for notes. See Attachments 2 and 3 for diagrams.

ATTACHMENT 6 NOTES TO STANDARD INTERWIRING

1. 115 Vac POWER

   Primary power is 115 Vac.

2. NOT USED

3. AUDIO MONITOR OUT

   To monitor information being stored, all channels combined, capable of driving 10 mW into a 600 ohm load, short circuit protected.

4. RECORD ENABLE

   Jumper in aircraft connector. Without this jumper the unit will not record or erase previously recorded information, audio erase will not activate and test will indicate NO-GO.

5. 28 Vdc POWER

   Pin 9 is for alternate DC power input of 28 Vdc. Pin 3 and/or Pin 17 provide the return connection for the DC Power (Pin 17 in ARINC 557). A jumper, Pin 1 to 2 may be installed to maintain compatibility with ARINC 557. The presence of this jumper should not damage the recorder.

6. RESERVED INT PRE-AMP ATTEN

   For Cockpit Voice Recorder units with internal microphone preamplifier. The microphone gain selection is from common jumper Pin 11 to Pins 20, 21, 22 individually or combined.

7. RESERVED TEST INDICATOR (Use is optional)

   Pins 15 and 16 are reserved for test indicator compatible with ARINC 557 (1mA equals “Good”). See Note 10.

8. **CHASSIS** GROUND CONNECTION

   Pin 17 (CVR) and Pin F (Control Unit) each grounded to the airframe within 1 foot of its respective connector using heavy gauge wire (#18 AWG or larger). For backward compatibility, the CVR and Control Unit Chassis Ground pins may be connected to each other by a wire. Shields are to be grounded at the recorder using short wires.

9. RESERVED DATA INPUT AND OUTPUT

   This optional data input/output is for a CVFDR. The data input signal originates in the FDAU. The format is defined in ARINC Characteristics 573, 717 and 747.

10. CVR FAULT

    Bite status output or recorder fault due to loss of power is indicated on Pin 23 for standard ground equals no fault, open equals fault or CVR not installed. The CVR test indicator wire Pins 15 and 16 (1 mA) may be omitted in installations where ARINC 557 compatibility is not needed. Either the CVR Fault or the Test Indicator (or both) should be wired in the aircraft.

11. AUDIO INPUTS

    Differential audio input, 3V RMS maximum, impedance 5K ohm minimum. Twisted shielded cable. Shield grounded to airframe with short connection.

12. RESERVED DATA LINK INPUT (Optional)

    See Section 3.9.

ATTACHMENT 6
NOTES TO STANDARD INTERWIRING

13. RESERVED OMS INPUT/OUTPUT (Optional)

    For OMS, ARINC 604 and ARINC 624. This output is shared for the purpose of supplying the return (handshaking) for data link recording using the ARINC 429 Williamsburg V1 protocol.

14. RESERVED ROTOR SPEED INPUT (Optional)

    CVR may accept Rotor Speed signal 2 Vac to 122 Vac RMS from 7 to 6,000 Hz, 1 sample per 0.5 seconds minimum, Accuracy 2% minimum. This rotor speed input complies with the frequency input defined in ARINC 573-7, Section 4.2.4 with the exception of recording accuracy and sampling rate which are defined in ED-112.

15. RESERVED AREA MICROPHONE INPUT (Optional)

    For systems with internal microphone preamplifier and limited microphone cable length. This is a low level signal (3 mV) and requires short exposed wire length with careful shielding.

16. AUDIO ERASE CIRCUIT

    Additional external interlock circuitry is required to prevent inadvertent activation. See Section 3.1.2 and Attachment 7.

17. FDR FAULT

    BITE status output of the data recording function. Standard ground equals no fault, open equals fault or recorder not installed. See ED-112 for further details.

18. UTC IN (Universal Time – Optional)

    ARINC 429 clock input is optional. The label for the clock is 125 for BCD or 150 for binary.

19. STOP CVR RECORDING

    Set to ground to stop audio and data link recording in 10 minutes (see Section 3.11). May be connected to aircraft interlocks.

20. FDR DATA RATE (Optional)

    Defines the rate of the received data from the FDAU:

Pin 29	Pin 38	Rate (Words/Sec)
OPEN	OPEN	64 or 1024
OPEN	GND	128
GND	OPEN	256
GND	GND	512

21. CVR REPLAY INHIBIT/FDR INHIBIT

    Grounding pin 44 will inhibit the operation of the FDR function (if available). This may be wired via appropriate interlocks. See ED-112 for further details.

    A test switch to open the circuit and enable the recorder may be desired to facilitate ground testing (see control unit pins FDR INHIBIT).

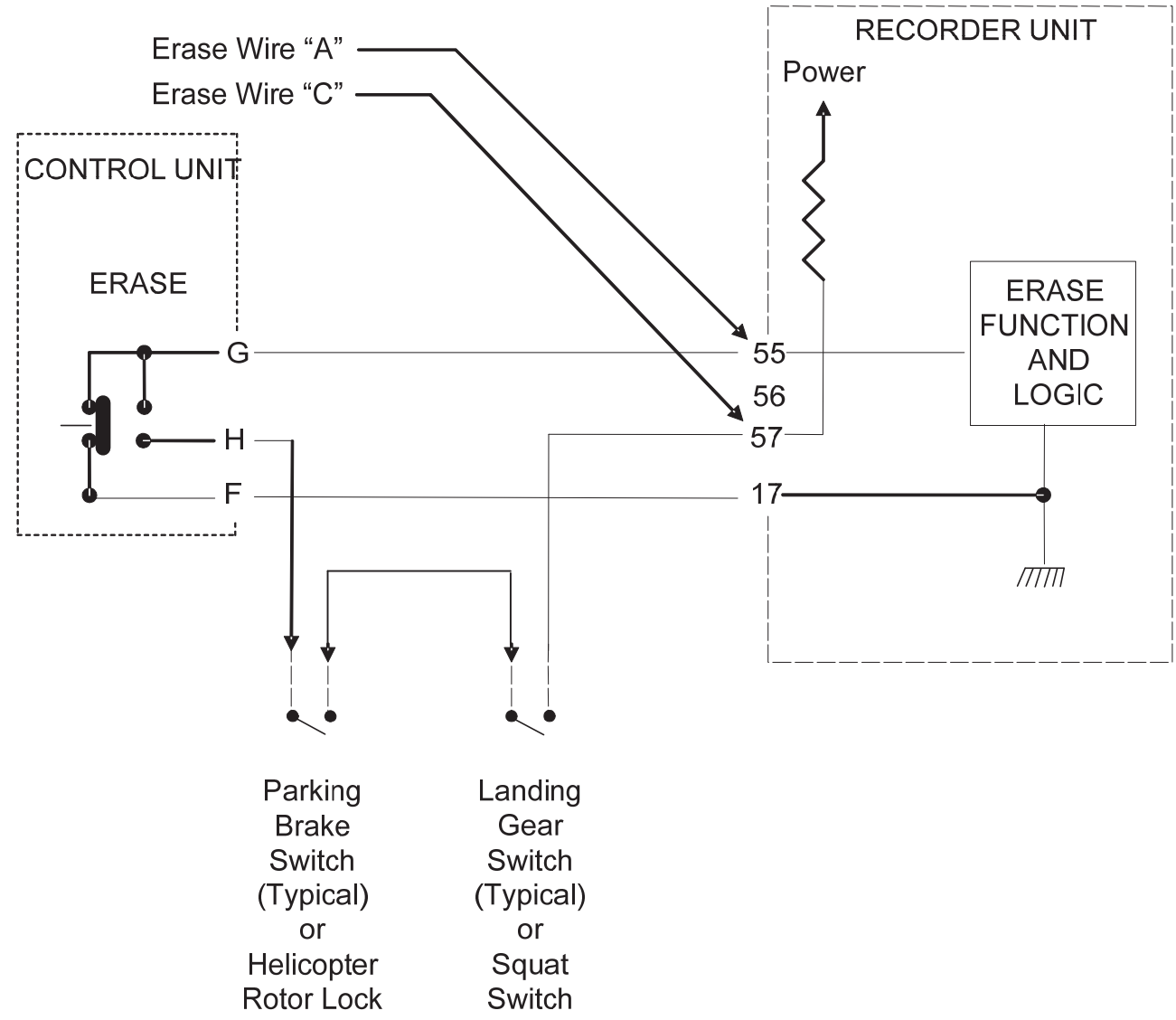
    If the recorder only supports the CVR function, pin 44 may be used to inhibit audio replay in configurations where Record Enable (pins 7 and 8) is controlled by logic. When Record Enable (pins 7-8) is not jumpered, pin 44 can be used in conjunction with pins 7-8 to inhibit audio replay. In this case, pin 44 must be grounded in the aircraft wiring to inhibit audio replay.

ATTACHMENT 6
NOTES TO STANDARD INTERWIRING

22. FDR STATUS, INDICATOR POWER, AND FDR MAINTENANCE (OPTIONAL) FOR ARINC 747 COMPATIBILITY

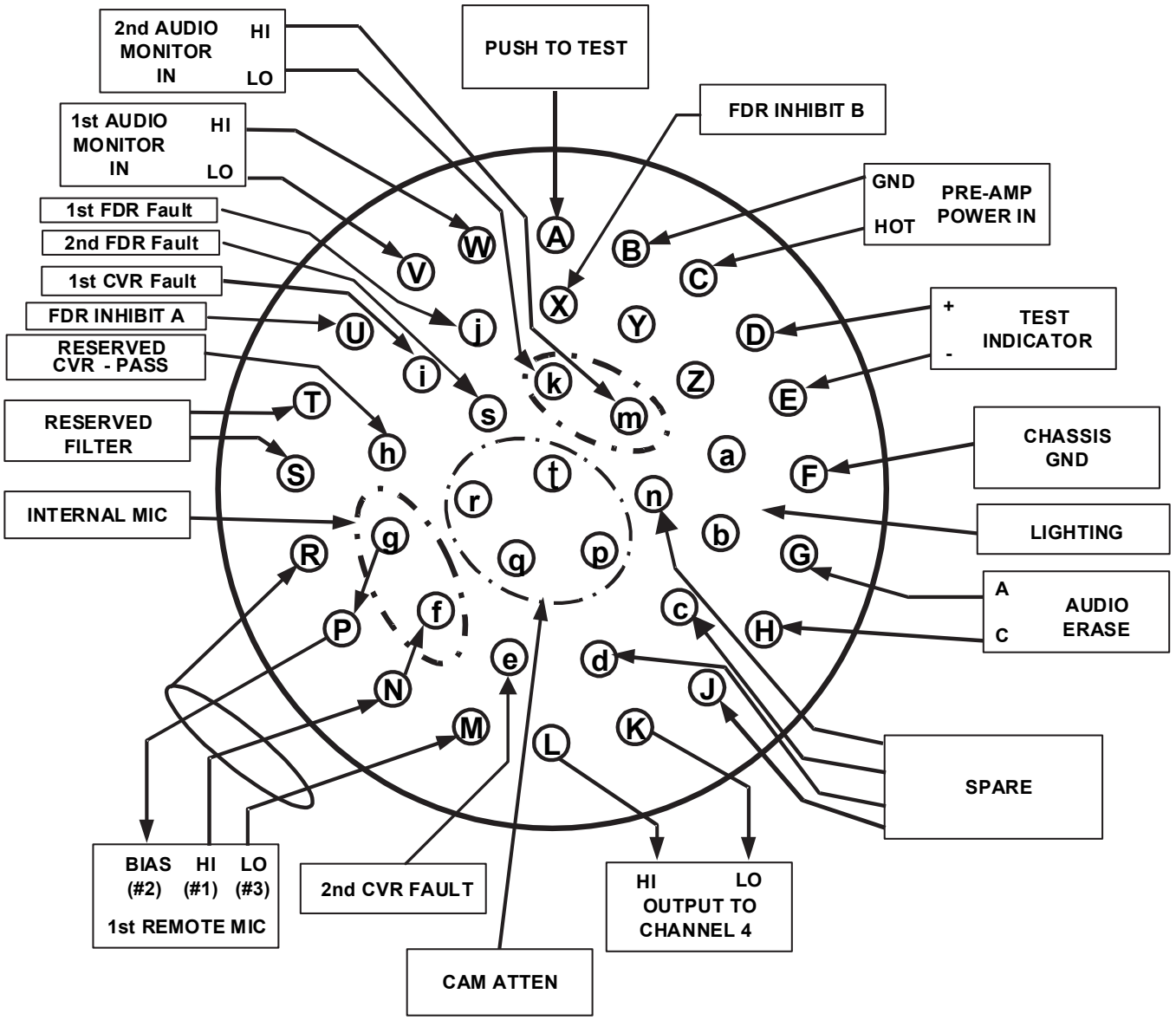
The status of the FDR system is indicated by FDR status (pin 36). If the system is operating normally, the voltage applied to Indicator Power Input (pin 4) is output on pin 36. Pin 36 is the same as ARINC 747 pin 21. Similarly, FDR Maintenance Pin 46 is the same as ARINC 747 pin 22. Indicator Power on pin 4 is the same as ARINC 747 pin 23.

ATTACHMENT 7 AUDIO ERASE CIRCUIT DETAILS



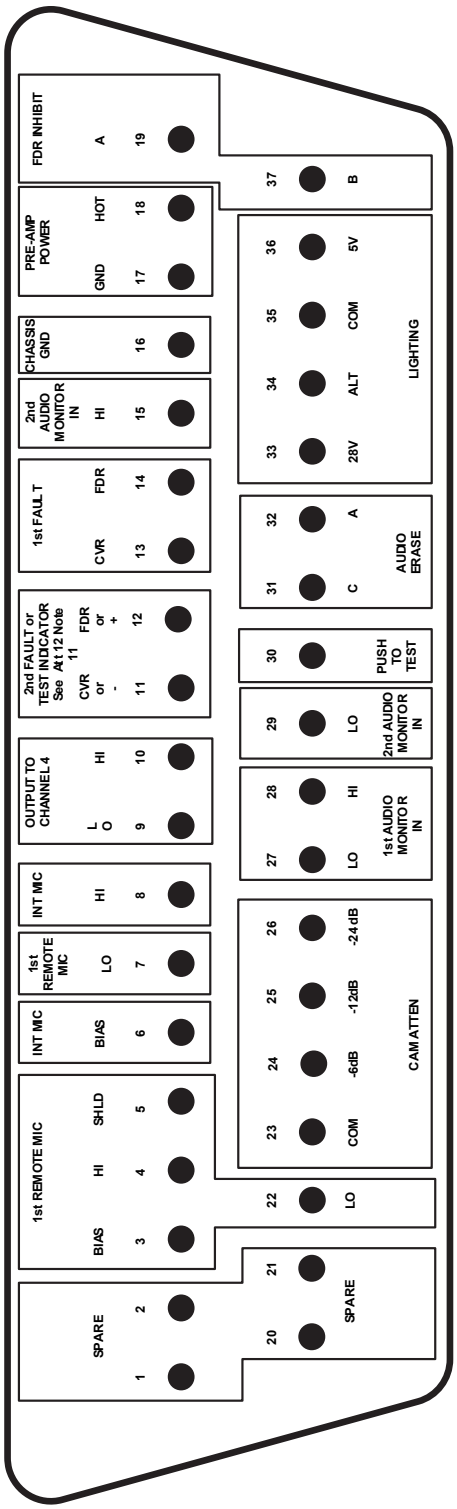
ATTACHMENT 8
CVR CONTROL UNIT CONNECTOR LAYOUT
TYPE MS3112-20-41P

ATTACHMENT 8 CVR CONTROL UNIT CONNECTOR LAYOUT TYPE MS3112-20-41P



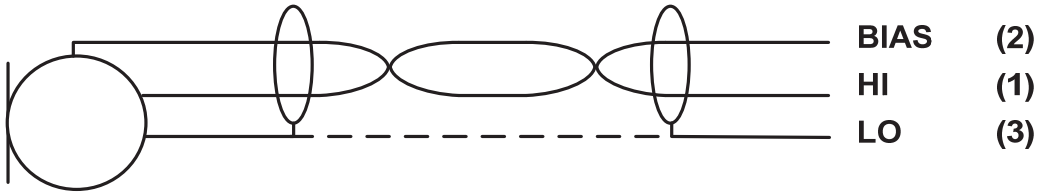
ATTACHMENT 9
CVR CONTROL UNIT CONNECTOR LAYOUT
MINIATURE CONTROL UNIT, 37 POSITION SIMILAR TO MIL-C-24308

ATTACHMENT 9 CVR CONTROL UNIT CONNECTOR LAYOUT MINIATURE CONTROL UNIT, 37 POSITION SIMILAR TO MIL-C-24308

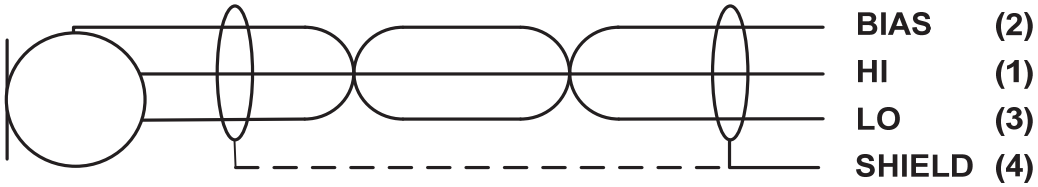


ATTACHMENT 10 MICROPHONE AND CABLE

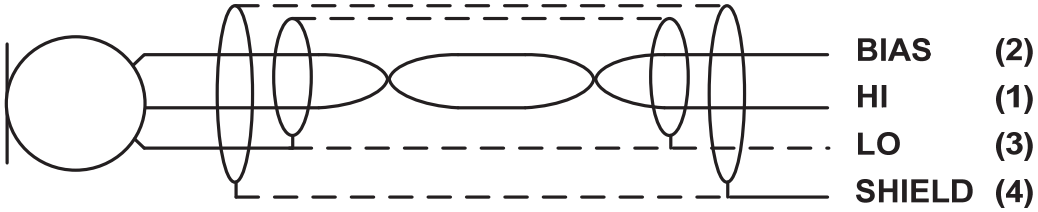
Earlier Systems According to ARINC 557
2-Conductor Twisted and Shielded Cable
(Shield is the Audio Return)



3-Conductor Twisted and Shielded



2-Conductor Twisted With Dual Shield



Microphone Sound Pressure Level (SPL) versus Record Level

(100 dB SPL = 20 DYNES/CM^2) = (Relative)
120 dB SPL = max (48 dB S/N)
90 dB SPL = (≈ 35 dB S/N)
60 dB SPL = min (0 dB S/N)

ATTACHMENT 11
CVR CONTROL UNIT STANDARD INTERWIRING
(41 AND 37) CONNECTOR

ATTACHMENT 11 CVR CONTROL UNIT STANDARD INTERWIRING (41 AND 37) CONNECTOR

FUNCTION	PIN 41-WAY CONN	PIN 37-WAY CONN	CVR	CVFDR	Dual CVFDR	NOTES	REMARKS
PUSH-TO-TEST	A	30	M	M	M		
PRE-AMP POWER IN GND	B	17	M	M	M	6	
PRE-AMP POWER IN HOT	C	18					
RES - TEST INDICATOR +	D	12	O	O	A	3 & 11	Alternate to 2nd CVR/FDR Faults
RES - TEST INDICATOR -	E	11					
CHASSIS GND	F	16	M	M	M		
AUDIO ERASE A	G	32	M	M	M		
AUDIO ERASE C	H	31	M	M	M		
SPARE	J	1					
OUTPUT TO CHANNEL 4 LO	K	9	M	M	M		
OUTPUT TO CHANNEL 4 HI	L	10					
REMOTE MIC LO (#3)	M	7, 22	M	M	M	4	
REMOTE MIC HI (#1)	N	4					
REMOTE MIC BIAS (#2)	P	3					
REMOTE MIC SHLD (#4)	R	5					
RES - FILTER COMMON	S	-	O	O	O		
RES - FILTER (1 kHz)	T	-					
RES - FDR INHIBIT A	U	19	O	M	M	10	
1st AUDIO MONITOR IN LO	V	27	M	M	M		
1st AUDIO MONITOR IN HI	W	28					
RES - FDR INHIBIT B	X	37	O	M	M	10	
RES - LIGHTING 5V	Y	36	O	O	O	1	
RES - LIGHTING COMMON	Z	35					
RES – LIGHTING ALTERNATE	a	34					
RES - LIGHTING 28V	b	33					
SPARE	c	21					
SPARE	d	20					
RES – 2nd CVR FAULT	e	11	O	O	A	8 & 11	Alternate to Test Indicator
RES - INTERNAL MIC HI (#1)	f	8	O	O	O	2	
RES - INTERNAL MIC BIAS (#2)	g	6					
RES - CVR PASS	h	-	O	O	O		
RES – 1st CVR FAULT	i	13	O	M	M	8	
RES – 1st FDR FAULT	j	14	O	M	M	9	
RES – 2nd AUDIO MONITOR IN LO	k	29	O	O	M		
RES – 2nd AUDIO MONITOR IN HI	m	15					
SPARE	n	2					
RES – CAM ATTEN (-6dB)	p	24	O	O	O	5	
RES – CAM ATTEN COMMON	q	23					
RES – CAM ATTEN (-12dB)	r	25					
RES – 2nd FDR FAULT	s	12	O	O	A	9 & 11	Alternate to Test Indicator
RES – CAM ATTEN (-24dB)	t	26	O	O	O	5	

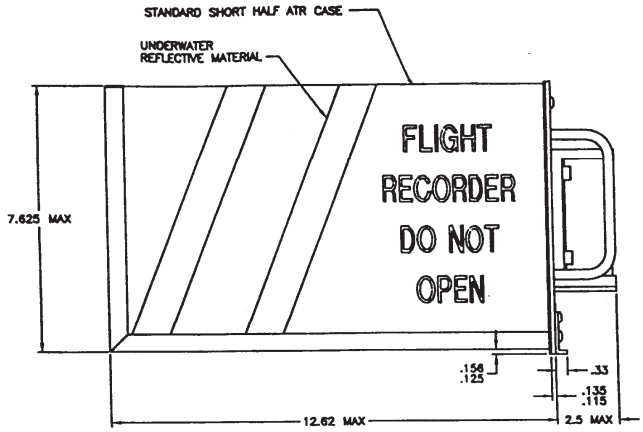
M = Function is a minimum requirement for this standard.
O = Function is optional.
A = Alternate configuration on 37-pin connector. One or both may be provided. See Attachment 12 for notes.

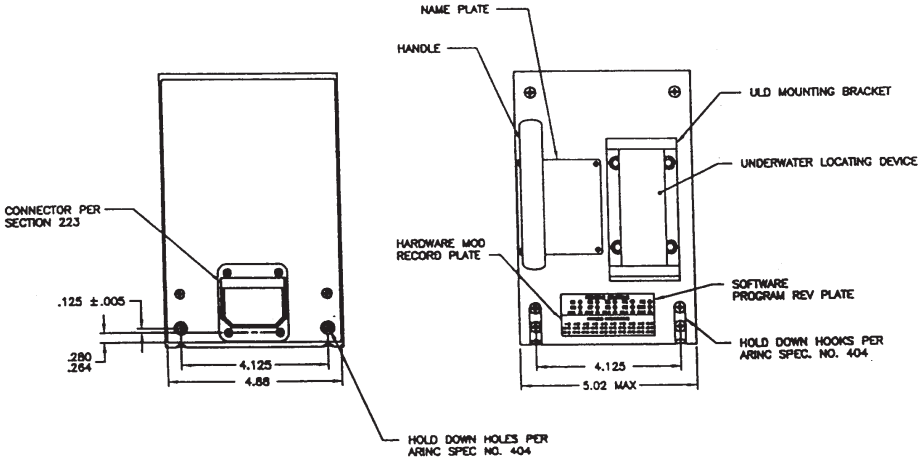
ATTACHMENT 12 NOTES TO CONTROL UNIT STANDARD INTERWIRING

1. Control unit lighting or illumination is an optional feature and aircraft dependent. Pins for ±5 Vdc and 28 Vdc are reserved. For other voltage levels, use pin (a) (Pin 34 on the 37-pin connector).
2. The internal microphone is connected through two external jumpers (which permit optional use of an external microphone). These two jumpers need to be short and inside the connector shield.
3. ARINC 757 systems using the CVR Fault BITE output connected to the control unit or other aircraft systems such as CMS, OMS, may omit this manual Test Indicator. This Test Indicator is used in ARINC 557 installations (1mA).
4. External microphones should use a 3-conductor shielded cable. Installations such as ARINC 557 installations with a 2-conductor twisted and shielded cable will work but they may not meet RTCA DO-160 requirements (see Attachment 10). Pin designations are given for analog microphone HI, BIAS, LO and SHIELD. Labels #1 through #4 are provided for alternate microphone types.
5. The control unit may permit selection of attenuation levels for the CAM preamplifier to accommodate the differing sound levels in various aircraft types. If used, the gain selection is from common jumper pin q (23) to pins p, r, or t, (24, 25, 26), individually or in combination. Attenuation values are additive.
6. DC power is provided by the recorder. The CVR system consists of a recorder together with its specific control unit. Intersystem interchangeability is not intended.
7. Not Used.
8. CVR Fault is the primary BITE status output of the ARINC 757 CVR. It may be wired to the control unit, or other aircraft systems, such as CMS, OMS, etc.
9. In a combined voice and data recorder the FDR Fault is a separate output for the data recorder section. It may be wired to the control unit or other aircraft systems, such as CMS, OMS, etc.
10. A switch may be provided on the control unit to enable operation of the FDR portion of the recorder (if available) for ground testing. This switch should be normally closed, and when open will enable data recording.
11. Pins 11 and 12 of the 37-pin connector have been used for both the Test Indicator and 2nd CVR/FDR Fault signals. Where a control unit is intended for use only with a CVR, these pins may be used for the Test Indicator. When the control unit is used with dual combination recorders, pins 11 and 12 should be used for the 2nd recorder’s fault signals.

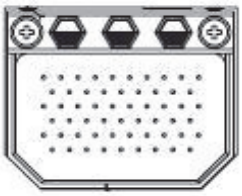
ATTACHMENT 13
OUTLINE AND DIMENSION

ATTACHMENT 13 OUTLINE AND DIMENSION

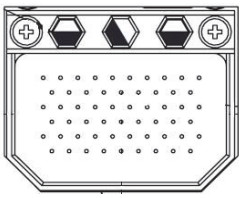




Recorder Connector Keying



Position 01 Keying

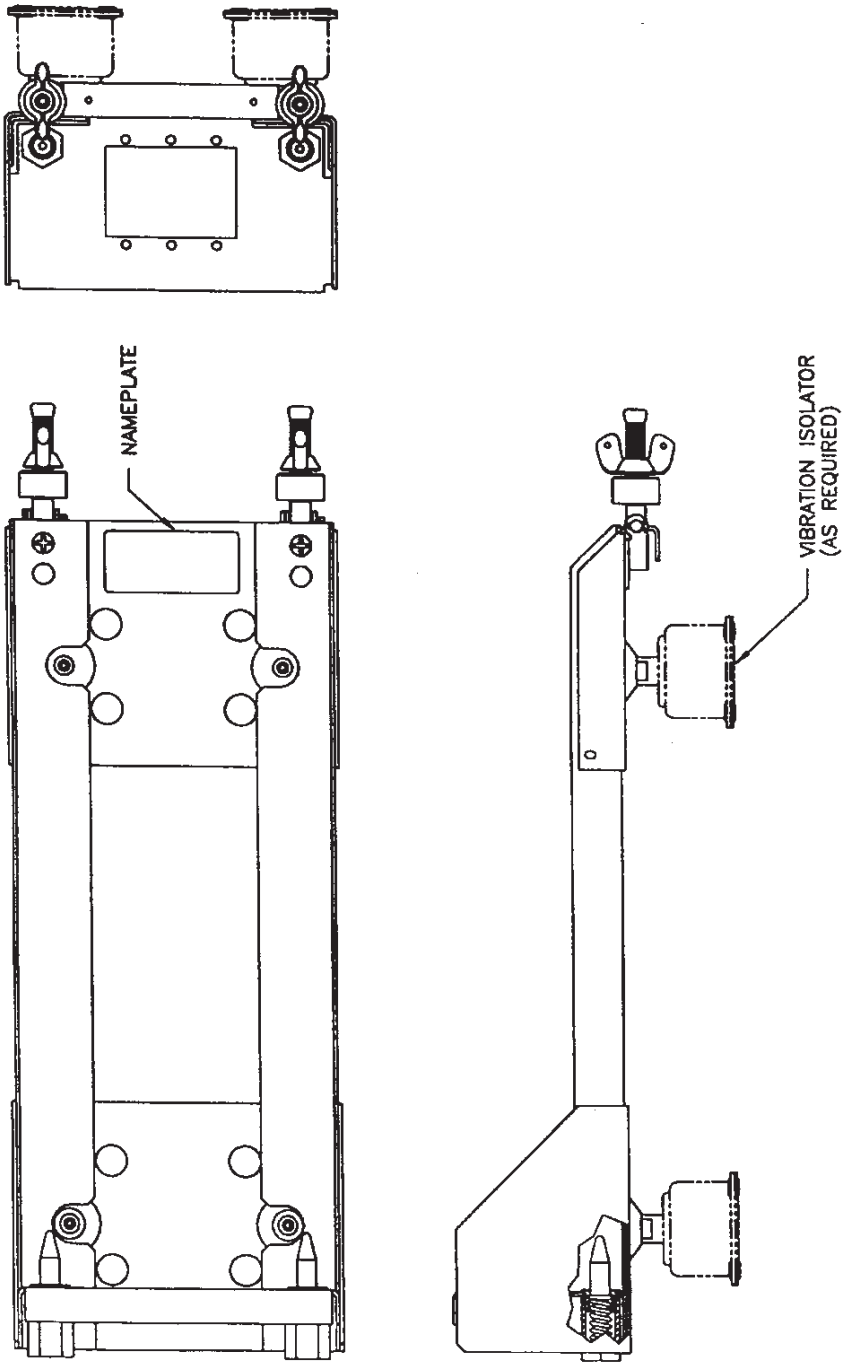


Non-Standard
(see Note 1)

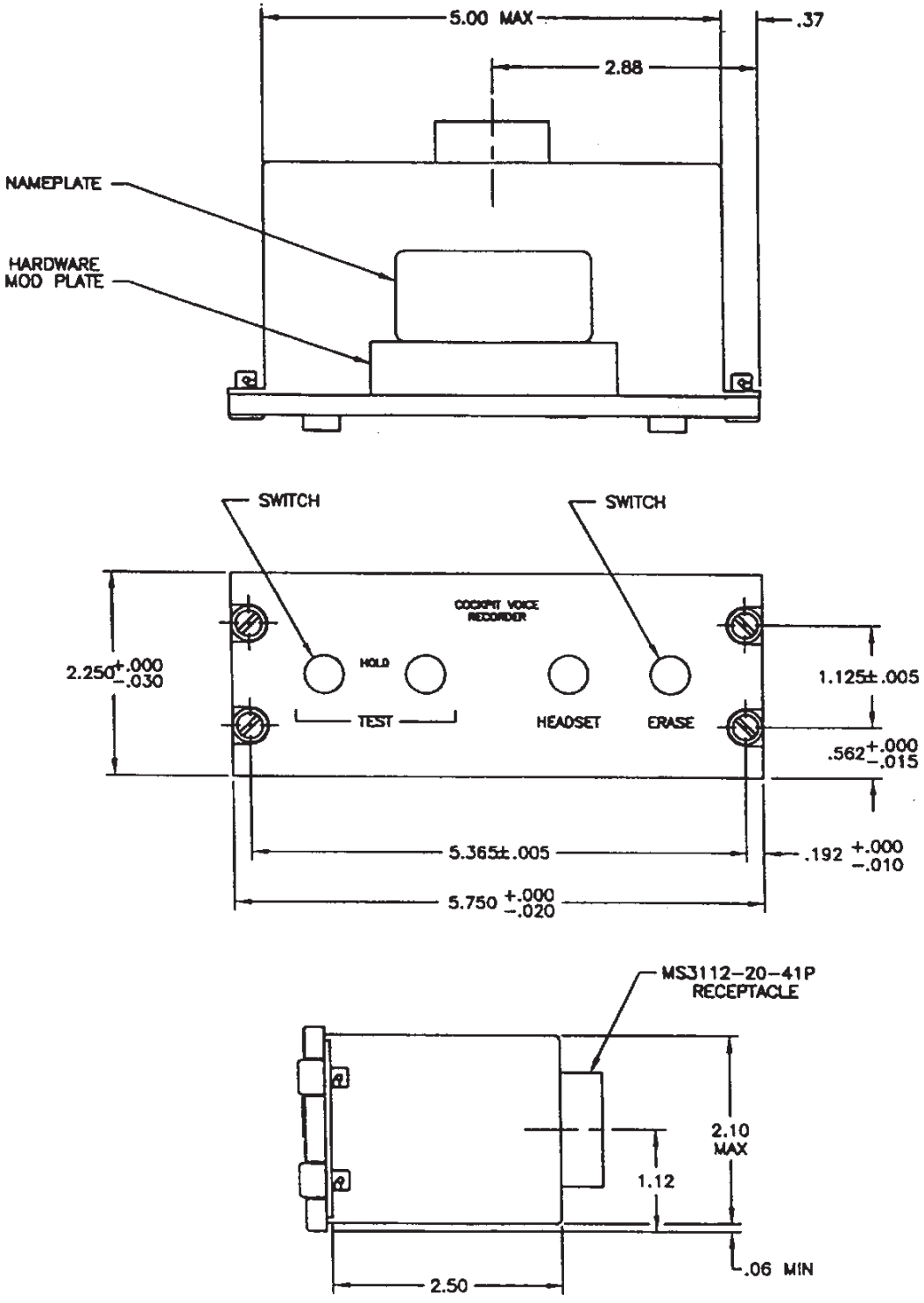
Keying Notes:

1. The keying is a manufacturer-specific non-standard configuration. See Section 2.2.3.
2. Darkened portion indicates extended part of post in receptacle. Light portion indicates key hole in receptacle.
3. Configuration shown is typical. Variations must comply with ARINC Specification 404A.

ATTACHMENT 14 CVR MOUNTING TRAY WITH OPTIONAL ISOLATORS



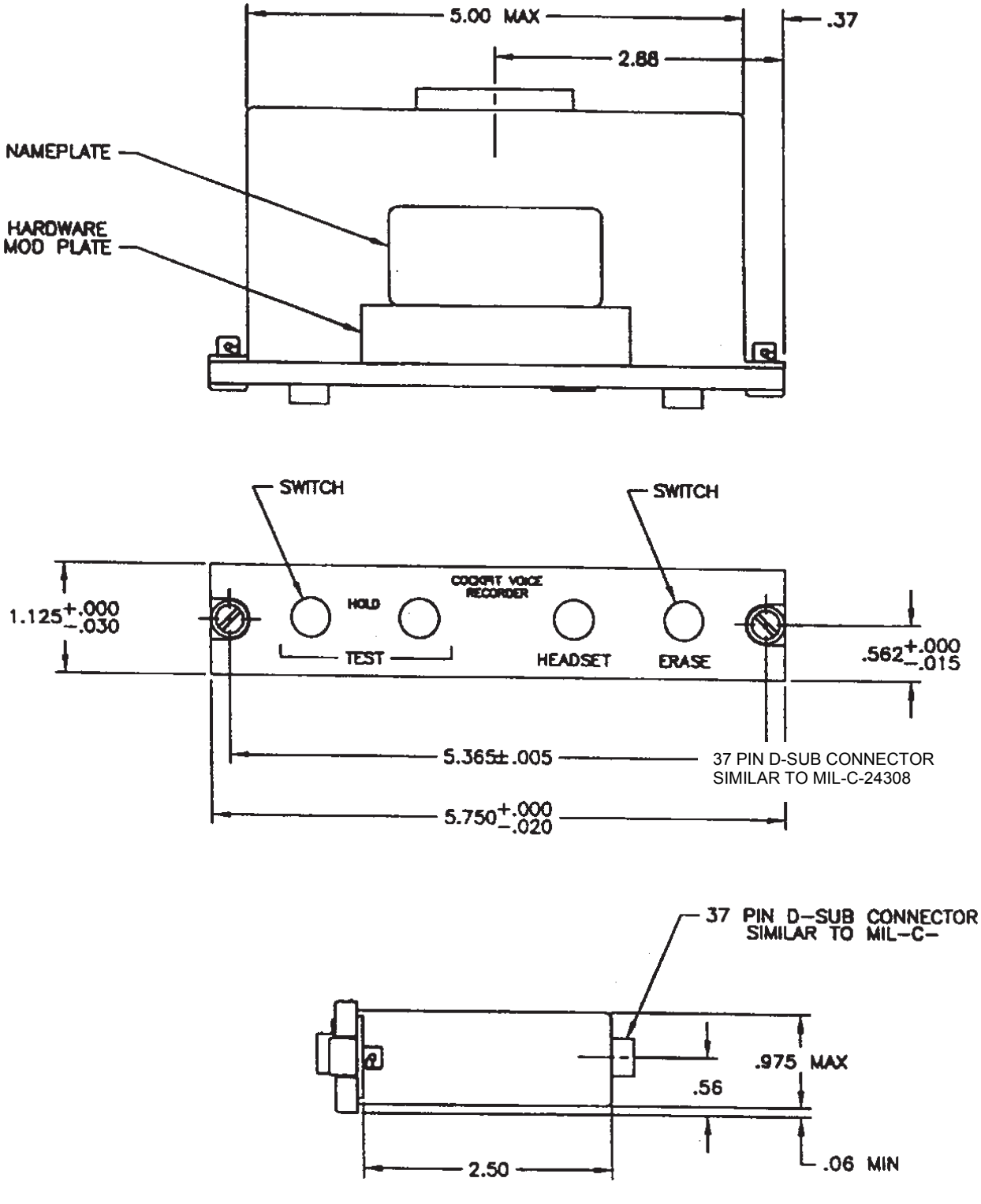
ATTACHMENT 15 OUTLINE AND DIMENSION, CONTROL UNIT



Note: Configuration Shown Is Typical

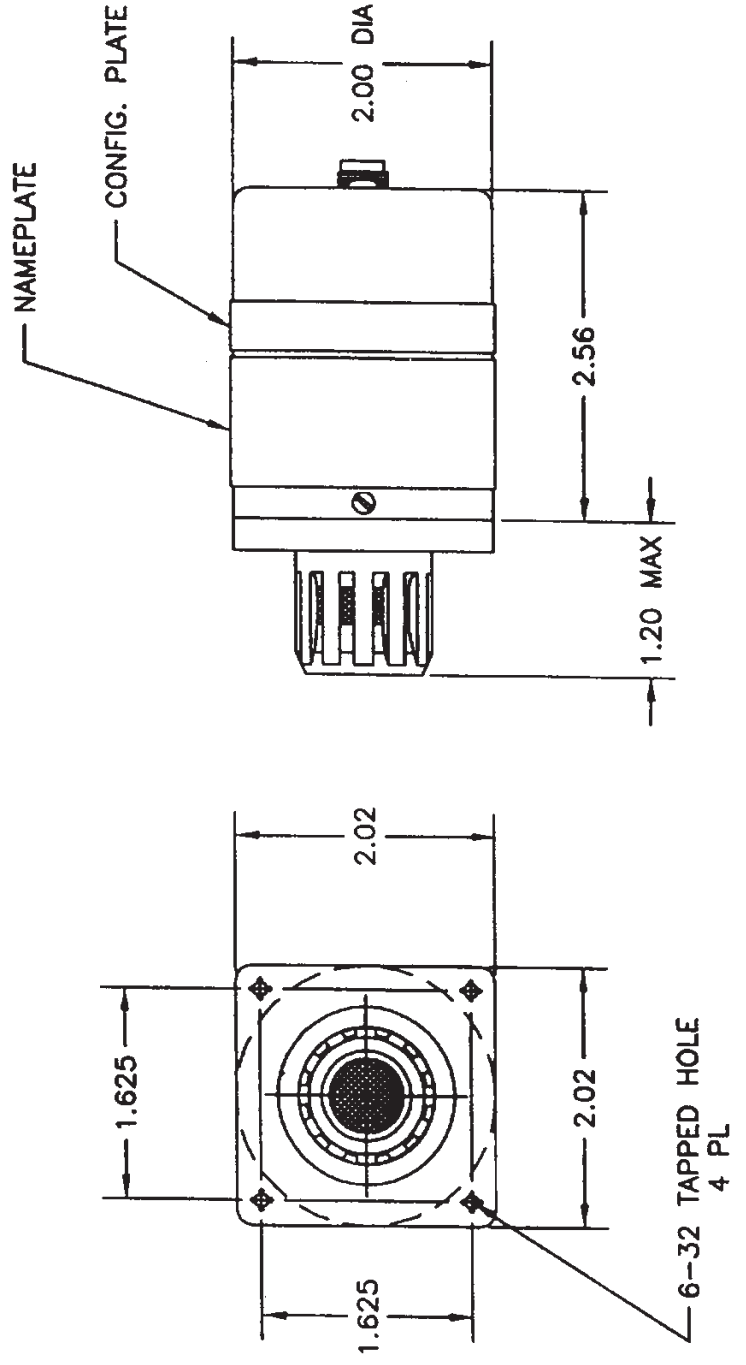
ATTACHMENT 16
OUTLINE AND DIMENSION, ALTERNATE MINIATURE CONTROL UNIT

ATTACHMENT 16 OUTLINE AND DIMENSION, ALTERNATE MINIATURE CONTROL UNIT



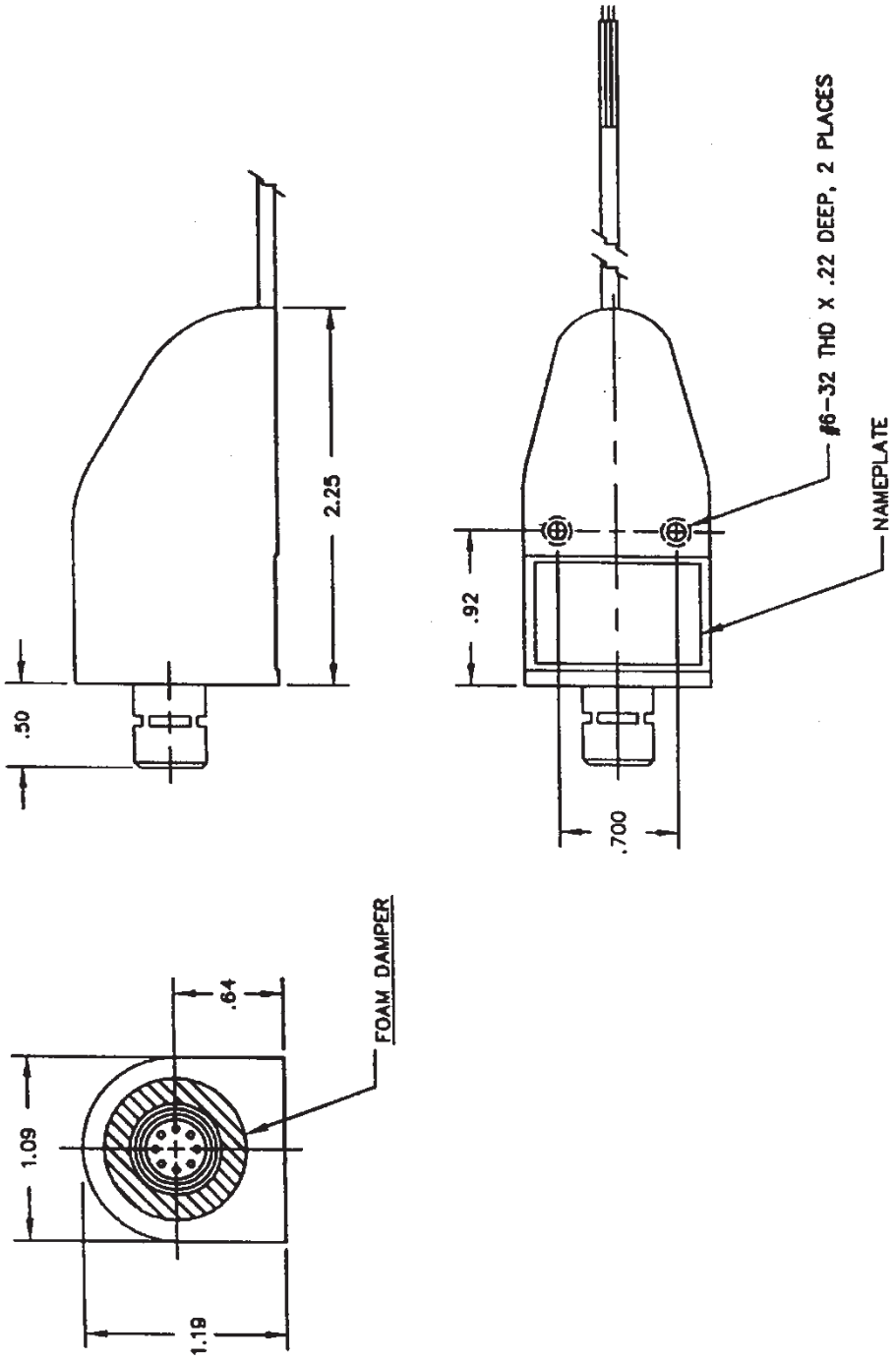
Note: Configuration Shown Is Typical

ATTACHMENT 17 OUTLINE AND DIMENSION, STANDARD MICROPHONE



ATTACHMENT 18
OUTLINE AND DIMENSION, ALTERNATE MINIATURE MICROPHONE

ATTACHMENT 18 OUTLINE AND DIMENSION, ALTERNATE MINIATURE MICROPHONE



NOTE:
CONFIGURATION SHOWN IS TYPICAL.

ATTACHMENT 19
RECORDER STATUS/OMS COMMAND WORD FORMAT

ATTACHMENT 19 RECORDER STATUS/OMS COMMAND WORD FORMAT

Recorder Status Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	SSM		SSM Ack	Test Inhibit	Reserved			Spare	FDR / CVR Inhibit	FDR Interface	Stop CVR Recording	RIPS Maint Status	CVR Record Disabled	D/L Interface	Clock Status	Data Link Recording	RIPS Status	FDR Status	Control Unit Status	OMS Bus Status	CVR Status	SDI		Label (350) LSB							MSB
Odd	SSM see below				Pad 0			Pad 0	1= FDR / CVR Replay Inhibit	1= Loss of Sync	1= Pin 10 GND	1 = Maint Reqd	1 = Disabled	Status 0 = OK, 1 = Failure									SDI see below		0	0	0	1	0	1	1	1

SSM Bits		
31	30	Status
0	0	Normal
0	1	NCD
1	0	Test
1	1	Failed

SDI Bits			
10	9	Device Ident	CVR Ident Pin
0	0	First Recorder	Open
0	1	Second Recorder	Gnd
1	0	Not Used	N/A
1	1	Not Used	N/A

NOTE: This definition of SSM bits is aligned with ARINC Specification 429 and shall be used with all new recorder designs.

Equipment built to previous versions of ARINC 757 (ARINC 757 to ARINC 757-5) may have used the older form of SSM encoding. This encoding may be found on legacy systems. It is provided below for information.

Reference Only		
SSM Bits		
31	30	Status
0	0	Not Used
0	1	Not Used
1	0	Test
1	1	Normal

OMS Command Word

BIT	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	P	Command							Equipment ID Code (057H) MSB											LSB	PAD		SDI		Label (227) LSB							MSB
		(See Below)							MSD			LSD+1				LSD					0	0	0	0	1	1	1	0	1	0	0	1

31	30	29	28	27	26	25	Command
0	0	0	0	0	0	0	Not Used
0	0	0	0	0	1	0	Ground Test Command
0	0	1	0	0	1	0	New Flight Leg – 000 Equipment Code
1	1	1	1	1	1	1	Log Off - 000 Equipment Code or CVR Specific Code

ATTACHMENT 20
FAULT AND STATUS OUTPUT CONDITIONS

State	CVR						RIPS		FDR									Data Link				OMS	CU	Clock
	CVR Replay Inhibit	CVR Fault (1)	Test Ind (2)	Audio Echo (3)	Stop CVR Recording	CVR Status (4)	CVR Record Disable (16)	Internal RIPS Maint	Internal RIPS Status (17)	FDR Inhibit	FDR Fault (5)	FDR Interface	FDR Status (6)	FDR Maint (18)	Data Echo (7)	Status(OMS) (8)	Data Link Fault (9)	Data Link Status (10)	Data Link Interface Status	Clock Status	CMC Bus Status (11)	Control Unit Status	Clock Status
Pin Number	44	23	15/16	5/6		na		na	na	44	24	na	36	46	18/19	na	31	na			na		
Recorder Status Word Bit Number	23				21	11	19	20	15	23		22				14		16	18	17	12	13	
Recorder not installed		x	x	x		na			na		x		na	x	x	na	x	na			na		
Recorder not powered		x	x	x		na			na		x		x	ox	x	na	x	na			na		
Recorder not functional (14)		x	x	x		na			na		x		x	ox	x	na	x	na			na		
Audio circuit failure		x	x	x		x																	
Recording medium or mechanism failure		x	x	x		x					x		x	x	x	x		x					
Failure to store in recording medium		x	x	x		x					x		x	x	x	x		x					
Insufficient audio, UTC or Rotor Speed recording duration		x	x	x		x																	
Insufficient power holdup capacity (Internal RIPS)		x	x	x					x														
RIPS Needs Maintenance								x															
Pin 10 Grounded					x																		
Pin 10 Grounded > 10 mins		x		x	x	x	x										x						
Pins 7-8 Not connected		x	x	x			x				*		*	*	*	*	x						
Pin 44 Grounded	x									x													
FDR self-test fault detected											x		x	x	x	x							
Missing or garbled FDR data stream											x	x	x	ox	x	x							
Data rate does not match config pins											x		x	ox	x	x							
Insufficient FDR recording duration											x		x	x	x	x							
FDR Inhibited (13)										x	x	x	x	ox	x	x							
FDR Function not present (15)											x		na	x	x	ox							
Missing Datalink heartbeat and Datalink Valid is asserted																	x	x					
Datalink heartbeat and Datalink Valid not asserted																		x					
Insufficient Datalink recording duration																	x	x					
No Data Link Function present																	x	ox					
Missing OMS heartbeat (see Section 4.2.1)																					x		
Missing Clock Information																				x			x
Control Unit Failure																						x	

ATTACHMENT 20
FAULT AND STATUS OUTPUT CONDITIONS

Notes applicable to table:

“x” means the signal is asserted.

“na” means the signal cannot be asserted. For example, if the recorder is not present or powered, it cannot report any of the OMS faults.

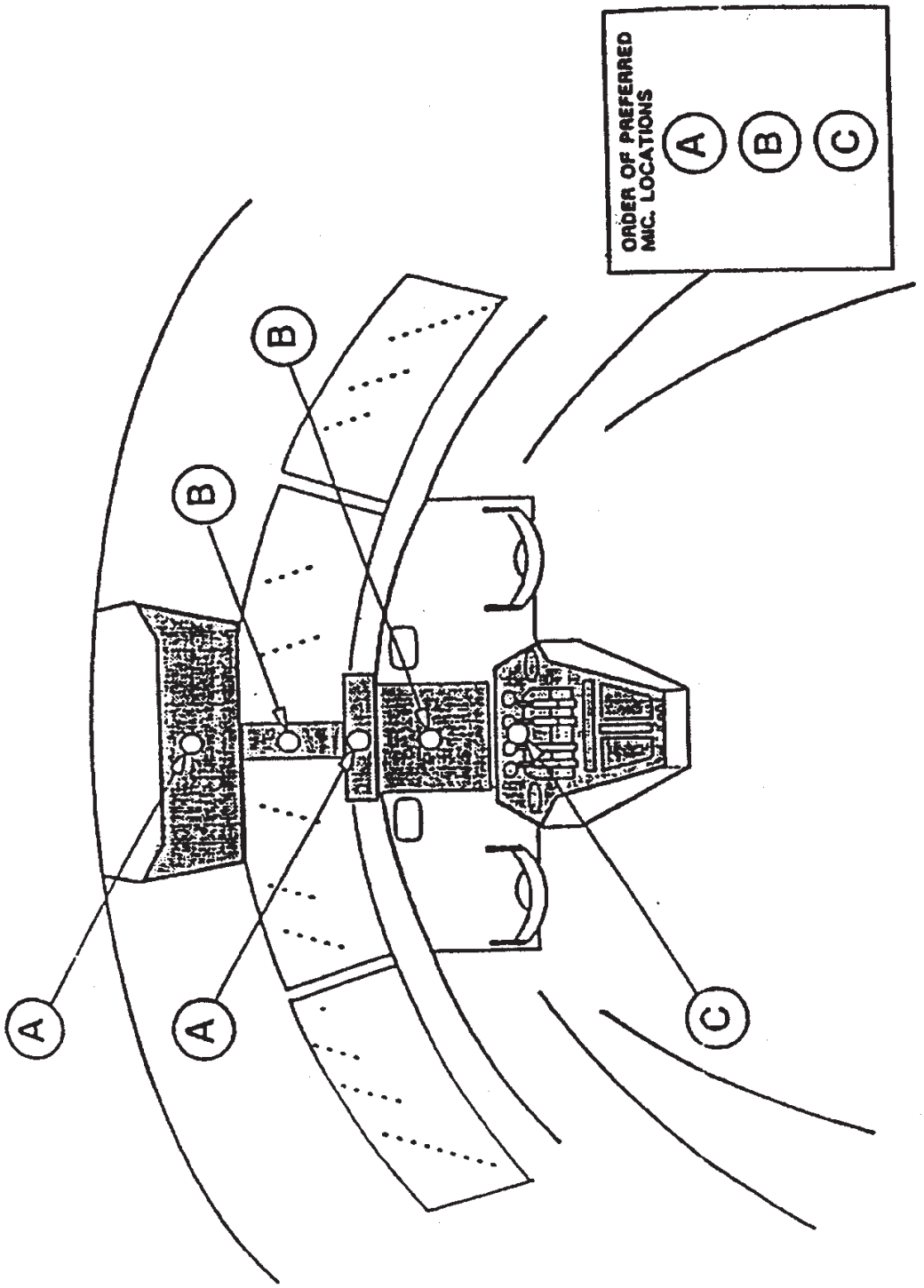
A blank means the signal is not asserted.

“ox” designates manufacturer option

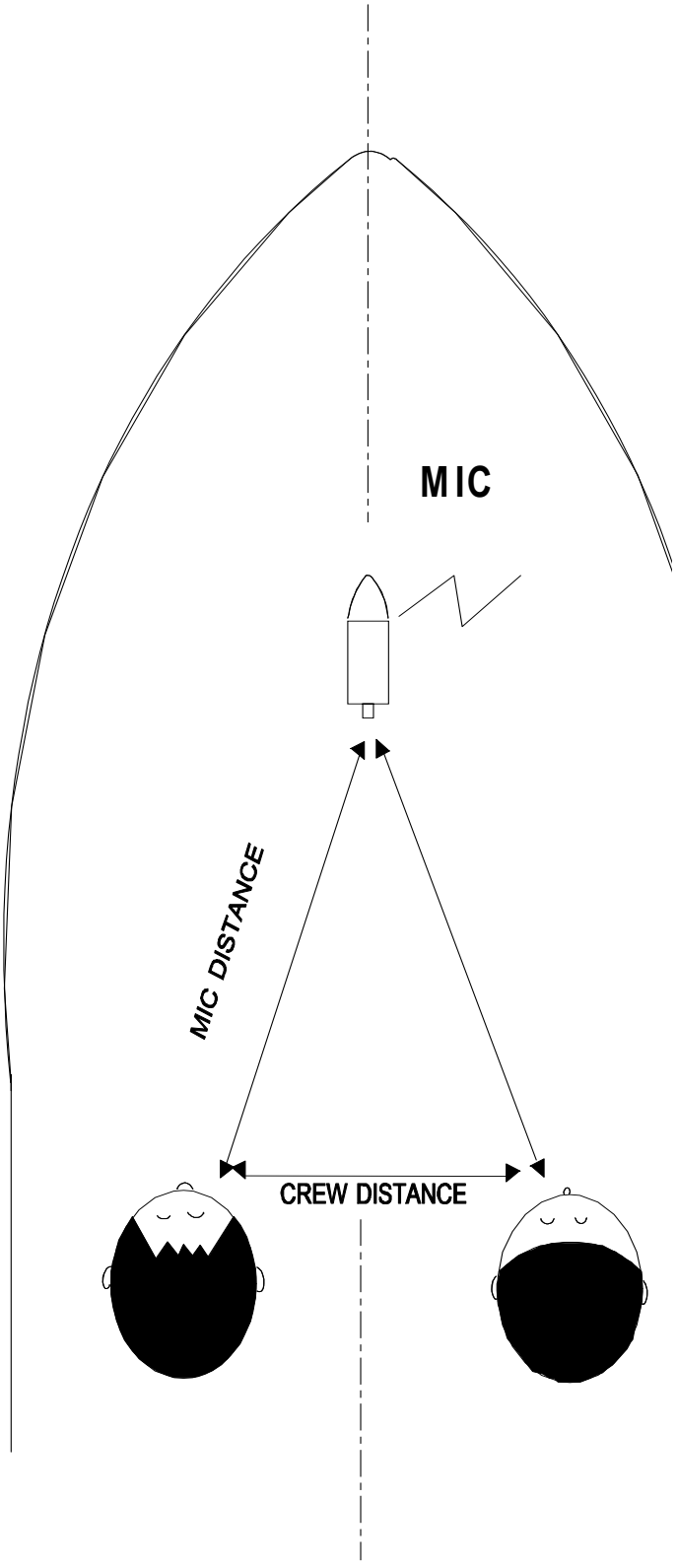
1. CVR Fault = Open/Ground discrete, Asserted is Open.
2. Test Ind = 1 mA through 250 ohm means "Good", asserted = < 0.8 mA, only valid during Initiated Test.
3. Audio Echo asserted means that the echo is disabled.
4. OMS CVR bit asserted = 1.
5. FDR Fault = Open/Ground discrete, Asserted is Open.
6. FDR Status = Open/Ground discrete, Asserted is Ground.
7. FDR Data Echo asserted means that the echo is disabled or not present.
8. OMS FDR bit asserted = 1.
9. Data Link Fault = Open/Ground discrete, Asserted is Open.
10. OMS Data Link bit asserted = 1.
11. OMS CMC bit asserted = 1.
12. Not Used
13. FDR Inhibited means Pin 44 = Gnd.
14. Recorder Not Functional means incapable of executing BITE.
15. FDR Function Not Present means that the recorder installed is a CVR rather than a combined CVR/FDR.
16. When CVR Record Disabled is asserted, recording is disabled, indicating that Pins 7-8 are open or that Pin 10 has been grounded for more than 10 minutes. See Section 3.11.
17. For definition of internal RIPS status, refer to ARINC Characteristic 777 RIPS No-Fault Discrete. An internal RIPS may only use OMS to report this fault.
18. FDR Maintenance = Open/Ground discrete, Asserted is Open.

* If “Record Enable” is used to control FDR recording, status/fault indications should be provided for the FDR function

APPENDIX A MICROPHONE LOCATIONS



APPENDIX B MICROPHONE SPACING



APPENDIX C LIST OF REFERENCE DOCUMENTS

Note: The latest revision of each document applies.

1. **ARINC Specification 404A:** *Air Transport Equipment Cases and Racking*
2. **ARINC Specification 404B:** *Air Transport Equipment Cases and Racking*
3. ~~**ARINC Specification 409A:** *Selection and Application of Semiconductor Devices*~~
4. **ARINC Specification 429:** *Digital Information Transfer System (DITS)*
5. **ARINC Characteristic 542A:** *Digital Flight Data Recorder*
6. **ARINC Characteristic 557:** *Airborne Voice Recorder (obsolete)*
7. **ARINC Characteristic 573:** *Aircraft Integrated Data System Mark 2 (AIDS)*
8. **ARINC Characteristic 585:** *Aircraft Chronometer System*
9. **ARINC Specification 600:** *Air Transport Avionics Equipment Interfaces*
10. **ARINC Report 604:** *Guidance for Design and Use of Built-In Test Equipment*
11. **ARINC Report 607:** *Design Guidance for Avionic Equipment*
12. **ARINC Specification 608A:** *Design Guidance for Avionics Test Equipment, Part 1, System Definition*
13. **ARINC Report 609:** *Design Guidance for Aircraft Electrical Power Systems*
14. **ARINC Report 624:** *Design Guidance for Onboard Maintenance System*
15. **ARINC Specification 626:** *Standard ATLAS for Modular Test*
16. **ARINC Report 627:** *Programmers Guidance for SMART™ Systems using ARINC 626 ATLAS*
17. **ARINC Characteristic 717:** *Flight Data Acquisition and Recording System*
18. **ARINC Specification 720:** *Digital Frequency/Function Selection for Airborne Electronic Equipment*
19. **ARINC Characteristic 747:** *Flight Data Recorder*
20. **ARINC Characteristic 757A:** *Cockpit Voice Recorder*
21. **ARINC Characteristic 777**: *Recorder Independent Power Supply (RIPS)*
22. **ATA Specification 100:** *Specification for Manufacturers' Technical Data dated June 1, 1956*
23. **EUROCAE ED-93:** *Minimum Aviation System Performance Specification for CNS/ATM Message Recording Systems*
24. **EUROCAE ED-112:** *Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems*
25. **FAA-TSO C-123b:** *Cockpit Voice Recorder System*
26. **RTCA DO-160/EUROCAE ED-14:** *Environmental Considerations and Test Procedures for Airborne Equipment*
27. **RTCA DO-178/EUROCAE ED-12:** *Software Considerations in Airborne Systems and Equipment Certification*
28. **RTCA DO-214:** *Audio System Characteristics and Minimum Operational Performance Standards for Aircraft Audio*

APPENDIX C
LIST OF REFERENCE DOCUMENTS

29. **RTCA DO-254/EUROCAE ED-80:** *Design Assurance Guidance for Airborne Electronic Hardware*
30. **SAE Report Committee S7:** *Cockpit Standardization Project*
31. **MIL-C-81659:** *Connectors, Electrical Rectangular, Crimp Contact*
32. **Military Standard No. MIL-STD-704:** *Characteristics and Utilization of Aircraft Electric Power* (This document supersedes **MIL-E-7894A:** *Electric Power, Aircraft, Characteristics of*)

APPENDIX D GUIDANCE MATERIAL FOR INSTALLATION OF COMBINED VOICE AND FLIGHT DATA RECORDERS

D-1.0 Introduction

Some airlines have expressed a wish to use the combined voice and data recorder described in this characteristic to provide partial or full redundancy in the recording of flight data and/or voice. The two basic configurations considered are a combined recorder in the CVR position (providing redundancy of data recording) or two combined recorders (providing full redundancy). This appendix provides guidance for the installation of combined recorders in these two basic configurations. See Figures D-1 and D-2.

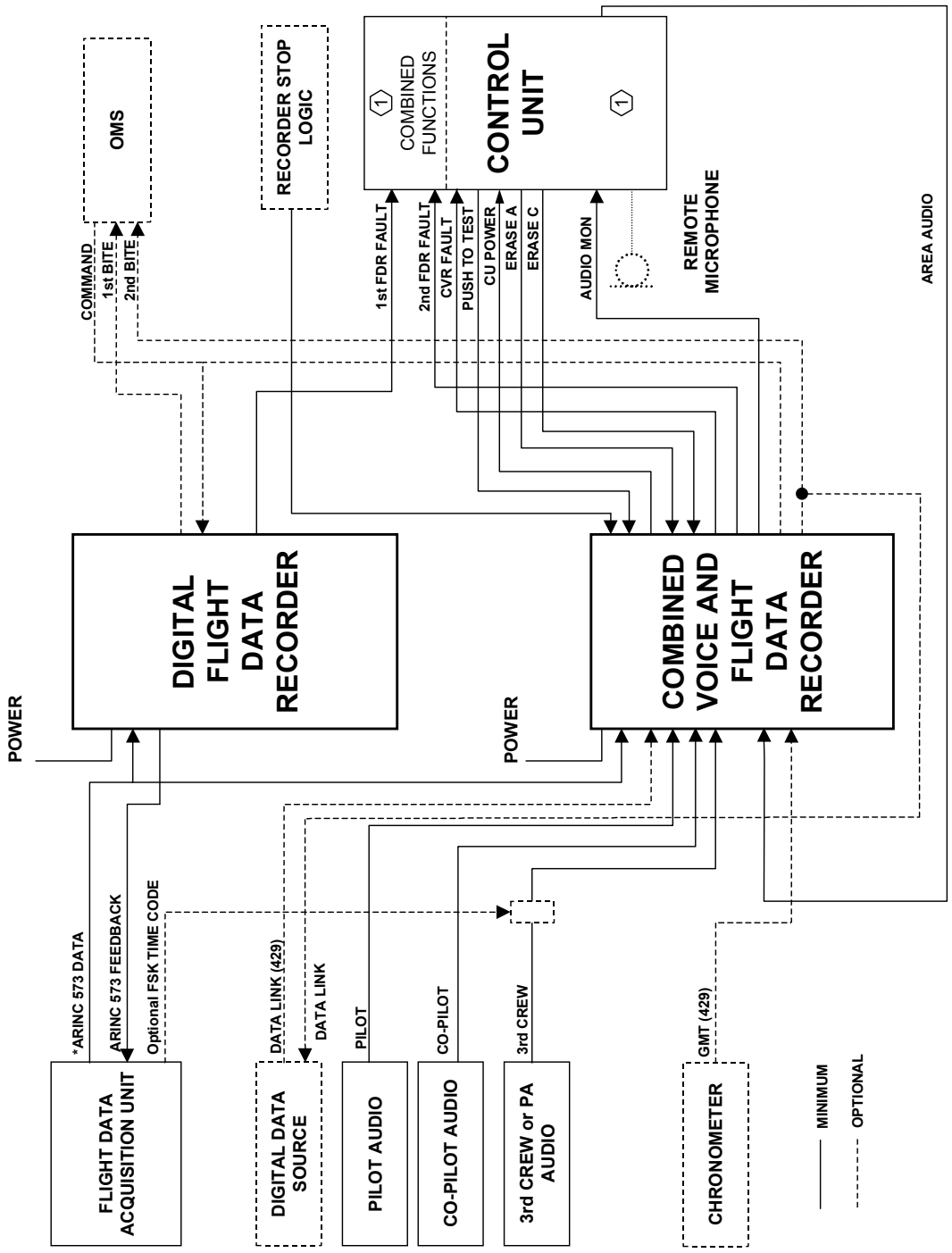
D-1.1 Standard Interwiring

The standard interwiring for the combined recorder is essentially the same as for the CVR, with the exception that the optional FDR functions need to be connected. In addition, the airline may gain benefit from providing separate failure indications for each recorder. Figure D-3 shows standard wiring providing these additional features.

D-1.2 Control Unit

Figures D-3a and D-3b show additional wiring for the control unit where the operator wishes to have separate indications from each recorder function. Figures D-4a and D-4b show possible outlines for control panels.

APPENDIX D
GUIDANCE MATERIAL FOR INSTALLATION OF COMBINED VOICE AND FLIGHT DATA RECORDERS

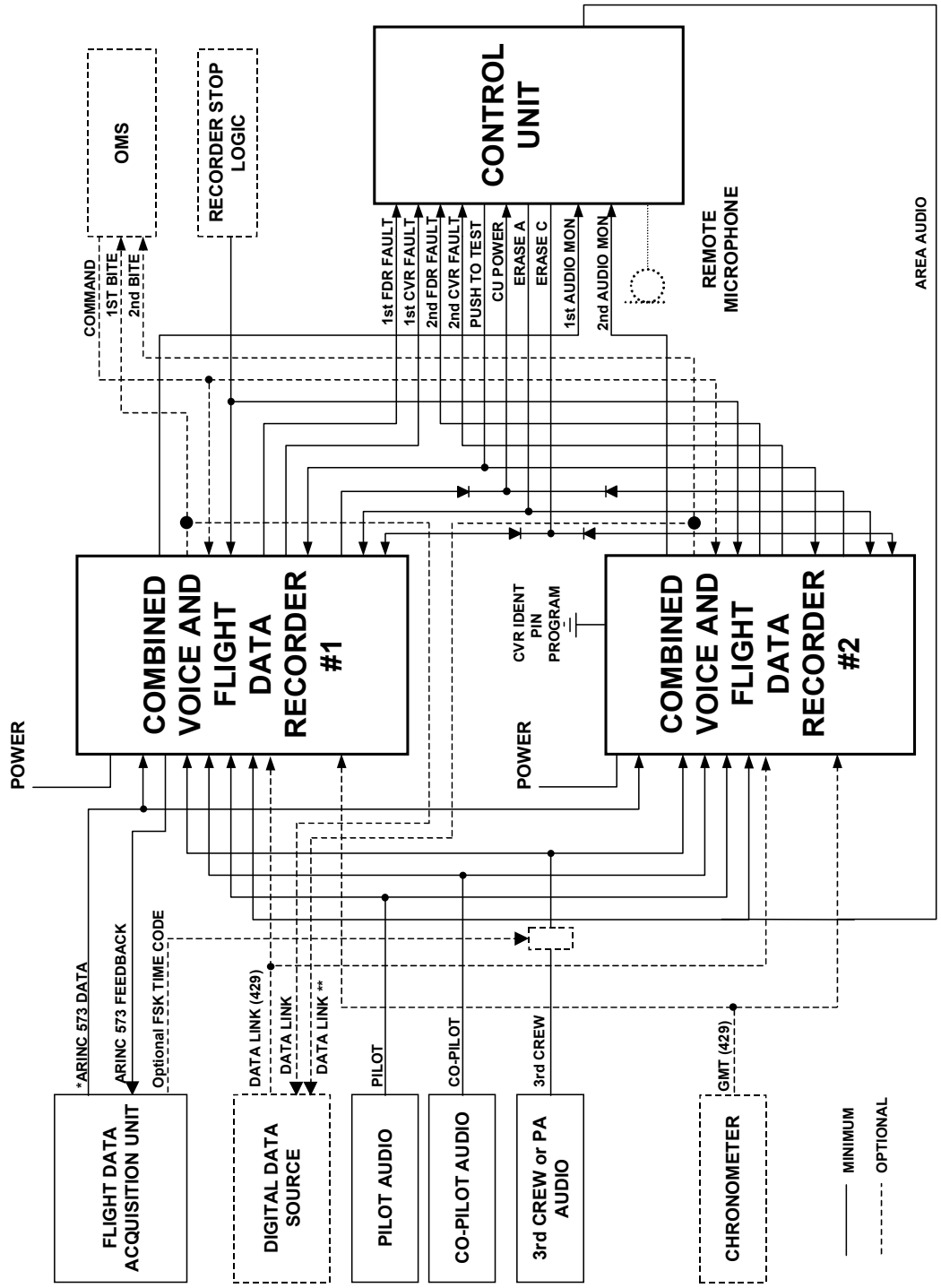


1 Combined functions may be optionally combined into one or more control panels.

* If a second output is available, it should be connected to the combi recorder.

Figure D-1 – System Block Diagram (Combined Recorder in CVR Position)

APPENDIX D
GUIDANCE MATERIAL FOR INSTALLATION OF COMBINED VOICE AND FLIGHT DATA RECORDERS

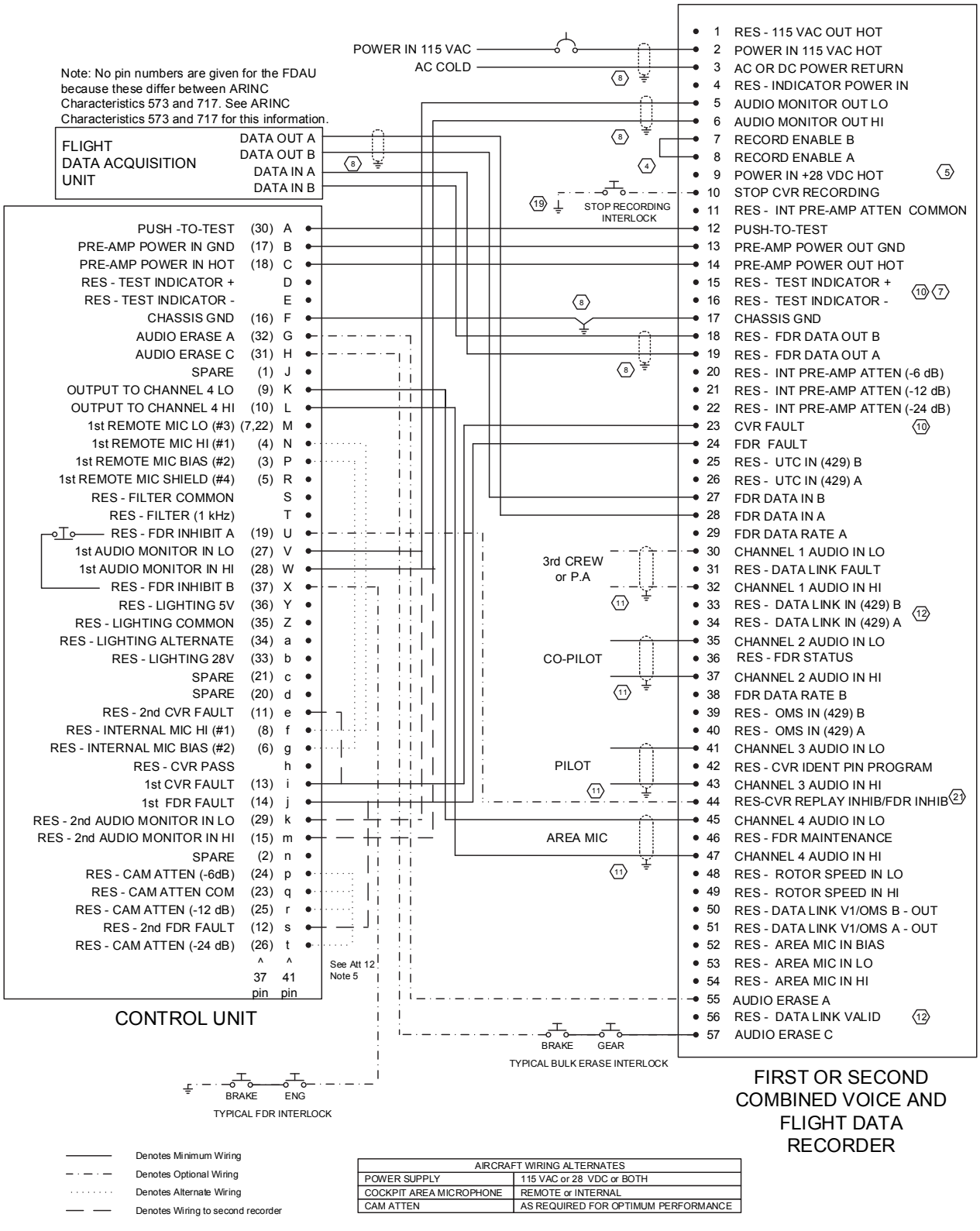


*If a second output is available, it should be connected to the second combi.

**ATSU only

Figure D-2 – System Block Diagram (Two Combined Recorders)

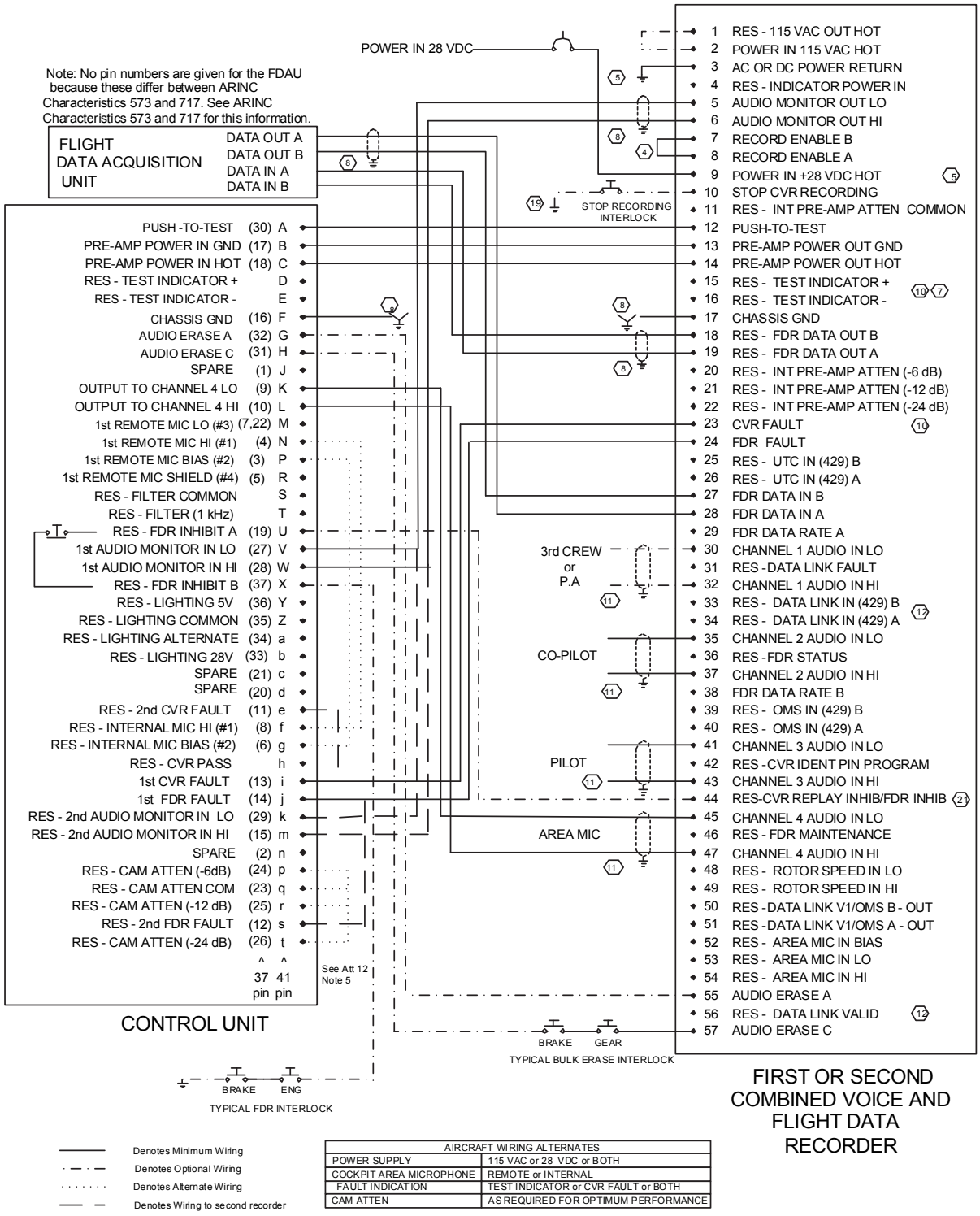
APPENDIX D
GUIDANCE MATERIAL FOR INSTALLATION OF COMBINED VOICE AND FLIGHT DATA RECORDERS



See Attachment 6 for notes.

Figure D-3a – Standard Interwiring (AC Power)

APPENDIX D
GUIDANCE MATERIAL FOR INSTALLATION OF COMBINED VOICE AND FLIGHT DATA RECORDERS

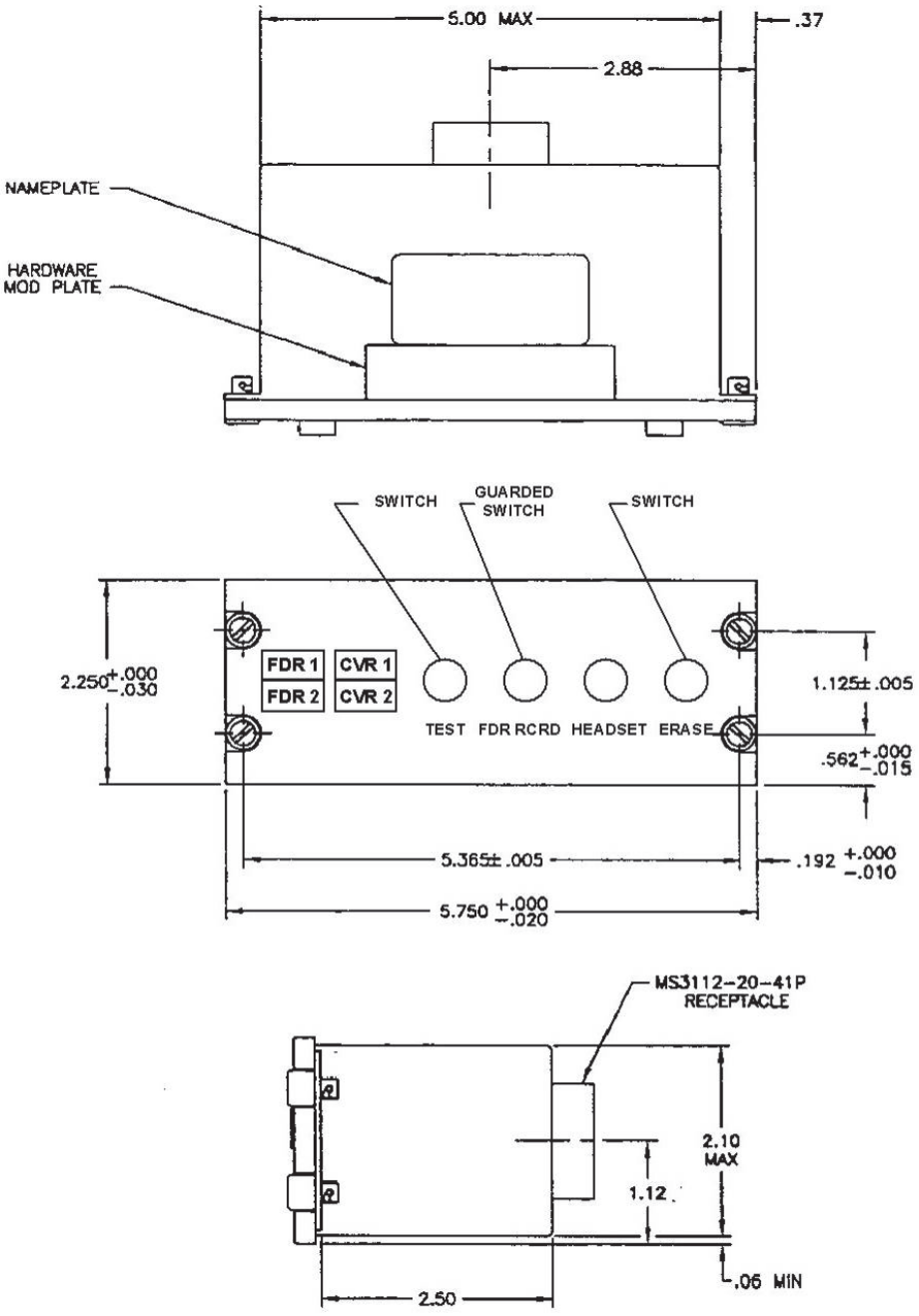


AIRCRAFT WIRING ALTERNATES	
POWER SUPPLY	115 VAC or 28 VDC or BOTH
COCKPIT AREA MICROPHONE	REMOTE or INTERNAL
FAULT INDICATION	TEST INDICATOR or CVR FAULT or BOTH
CAM ATTEN	AS REQUIRED FOR OPTIMUM PERFORMANCE

See Attachment 6 for notes.

Figure D-3b – Standard Interwiring (DC Power)

APPENDIX D
GUIDANCE MATERIAL FOR INSTALLATION OF COMBINED VOICE AND FLIGHT DATA RECORDERS



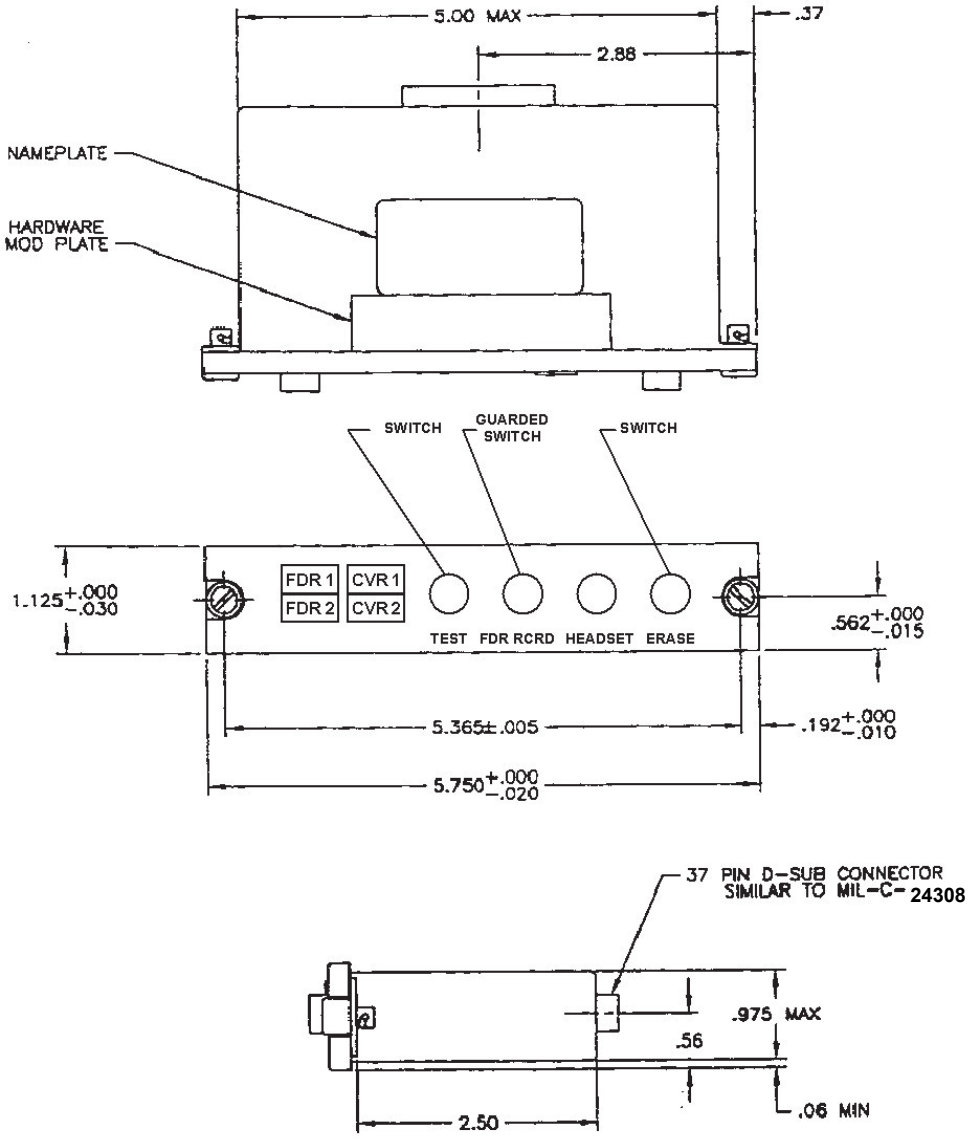
Notes:

Configuration shown is typical.

The 37-pin connector was originally intended for the miniature control unit (1.125 inches). However, it can optionally be used in the standard control unit (2.25 inches).

Figure D-4a – Outline and Dimensions Standard Control Unit

APPENDIX D
GUIDANCE MATERIAL FOR INSTALLATION OF COMBINED VOICE AND FLIGHT DATA RECORDERS



Notes:

Configuration shown is typical.

The 37-pin connector was originally intended for the miniature control unit (1.125 inches). However, it can optionally be used in the standard control unit (2.25 inches).

Figure D-4b – Outline and Dimensions, Alternate Miniature Control Unit

APPENDIX E INTERNAL OR EXTERNAL RIPS IMPLEMENTATION

E-1 General

This appendix provides design consideration for both internal and external Recorder Independent Power Supply (RIPS) implementations. A RIPS internal to the CVR will eliminate the need for an additional LRU and any changes to aircraft wiring. An external RIPS implementation could avoid replacement of an existing CVR. The market may require both versions. See ARINC Characteristic 777 for detailed discussion of RIPS.

COMMENTARY

It is envisioned that a bank of batteries or capacitors may comprise the RIPS energy storage. Advances are being made in rechargeable batteries, as well as super-capacitors. The supplier is cautioned to consider life-cycle issues, such as periodic maintenance, wear-out, safety hazards, disposal, and multi-source availability, when choosing their RIPS technology.

E-1.1 Goals

The goals in an implementation of a RIPS (internal or external) are as follows:

a. Meet regulations for functionality
b. Require no (or minimal) changes to existing aircraft wiring
c. Require no (or minimal) changes to existing recorders

~~Goals b and c are not compatible, and point to use of an internal or external RIPS, respectively.~~ The ~~additional~~ advantages and disadvantages of each implementation are listed in Sections E-2 and E-3 below.

E-1.2 Cascading Considerations

Several problems can arise when installing a standalone RIPS or a CVR with an internal RIPS in ~~existing~~ aircraft installations with a delay implemented by aircraft logic. These problems stem from the various ways in which the 10 minute delay for cessation of recording can be implemented. ~~In some cases~~**For example,** the engine-out discretes **could be** ~~are~~ wired to a time delay relay, which shuts off power to the CVR 10 minutes after the engines stop. **Alternatively,** ~~In other cases~~ the engine out discretes **could be** ~~are~~ wired to the Stop CVR Recording input on the CVR, which then internally **waits** ~~times~~ 10 minutes and then stops recording.

~~The Stop CVR Recording discrete is the preferred approach, and with this approach~~ **To ensure that** the recording will always stop at the **appropriate** ~~required~~ time**, the preferred approach is to utilize the Stop CVR Recording discrete**. Use of the time delay relay**, described above,** can cause cascading of the delays, resulting in 20 minutes of recording after engines stop **on the ground, 10 minutes due to the relay, and then 10 minutes due to the RIPS.** ~~. And if a CVR with an internal RIPS is installed in an aircraft with both an external RIPS and the Time Delay Relay, recording could continue 30 minutes after engines stop.~~

These problems can be addressed in the following manner:

- When installing an external RIPS in an aircraft that uses the time delay relay to stop recording, the power to the RIPS should not have the delay applied.

The time delay relay should be removed or replaced with a similar relay that has no delay.

- When installing a recorder with an internal RIPS in an aircraft that uses the time delay relay to stop recording, the aircraft should be modified to use the Stop CVR Recording input discrete instead of the delay relay or the time delay relay should be replaced with a similar relay that has no delay. There is no way for the recorder to distinguish between power interruption due to an incident (when it is required to record for 10 minutes more) and normal engine shutdown (in which case the relay has already timed the 10 minutes and recording should cease immediately).
- ~~When installing a recorder with an internal RIPS in an aircraft that already has an external RIPS installed, the system will only work properly if the aircraft uses the Stop CVR Recording input discrete.~~

~~In summary, there are only problems when the aircraft uses the Time Delay Relay to switch the recorder power. The preferred solution to resolve the problems is converting the aircraft to use the Stop CVR Recording discrete.~~

E-2 Internal RIPS

A recorder with an internal RIPS capability will store energy from the aircraft power supplied to the recorder, and use this stored energy to continue recording for 10 minutes after every normal or abnormal loss of power, subject to Cessation of Recording requirements. The input power can be either 115 Vac or 28 Vdc; the recorder accepts either or both at once. The recorder may segregate its functions such that only the CVR function continues, or it may sustain all functions (again subject to applicable Cessation of Recording requirements).

The recorder should monitor and report the health of the internal RIPS function. **When the OMS interface is provided, Reporting of the RIPS Fault and Maintenance Status is accomplished via the CVR OMS ARINC 429 output bus.**

If no OMS interface is provided, the internal RIPS fault is reported through the CVR Fault (Pin 23).

Any suitable energy storage technology may be used, but maintenance concerns may dictate that the storage element be replaceable without removing or opening the recorder. Also consideration should be given to limiting instantaneous power consumption during system power-up, since the combination of recorder inrush current and the storage recharge may overload the supply circuits.

In theory, the components of a RIPS are already present in a CVR due to the existing 200 millisecond holdup requirement. These include the voltage conversion, storage management, and supply functions. What changes is the capacity of the storage. In practice, the storage technology used may require different or additional circuitry.

E-3 External RIPS

Installing an external RIPS includes mounting the unit somewhere near the CVR, running wires from the aircraft 115 Vac and/or 28 Vdc supplies to the RIPS, and running wires from the RIPS to the 28 Vdc input on the CVR.

An external RIPS will store energy from the aircraft power (which may be separate from that supplied to the recorder) and use this stored energy to power the recorder

for 10 minutes after every normal or abnormal loss of power. The input power can be either 115 Vac or 28 Vdc. ~~the RIPS should accept either (or both at once).~~ The RIPS should monitor and report the health of the storage and supply functions.

Pin 10 may also include a RIPS Active discrete input which functions as a trigger to stop CVR recording. This is reported on the CVR OMS ARINC 429 output bus, when provided.

Any suitable energy storage technology may be used, but maintenance concerns may dictate that the storage element be replaceable easily. Also, consideration should be given to limiting instantaneous power consumption during system power-up, since the combination of recorder inrush current and the storage recharge may overload the supply circuits.

APPENDIX F GUIDANCE MATERIAL FOR INSTALLATION OF DATA LINK

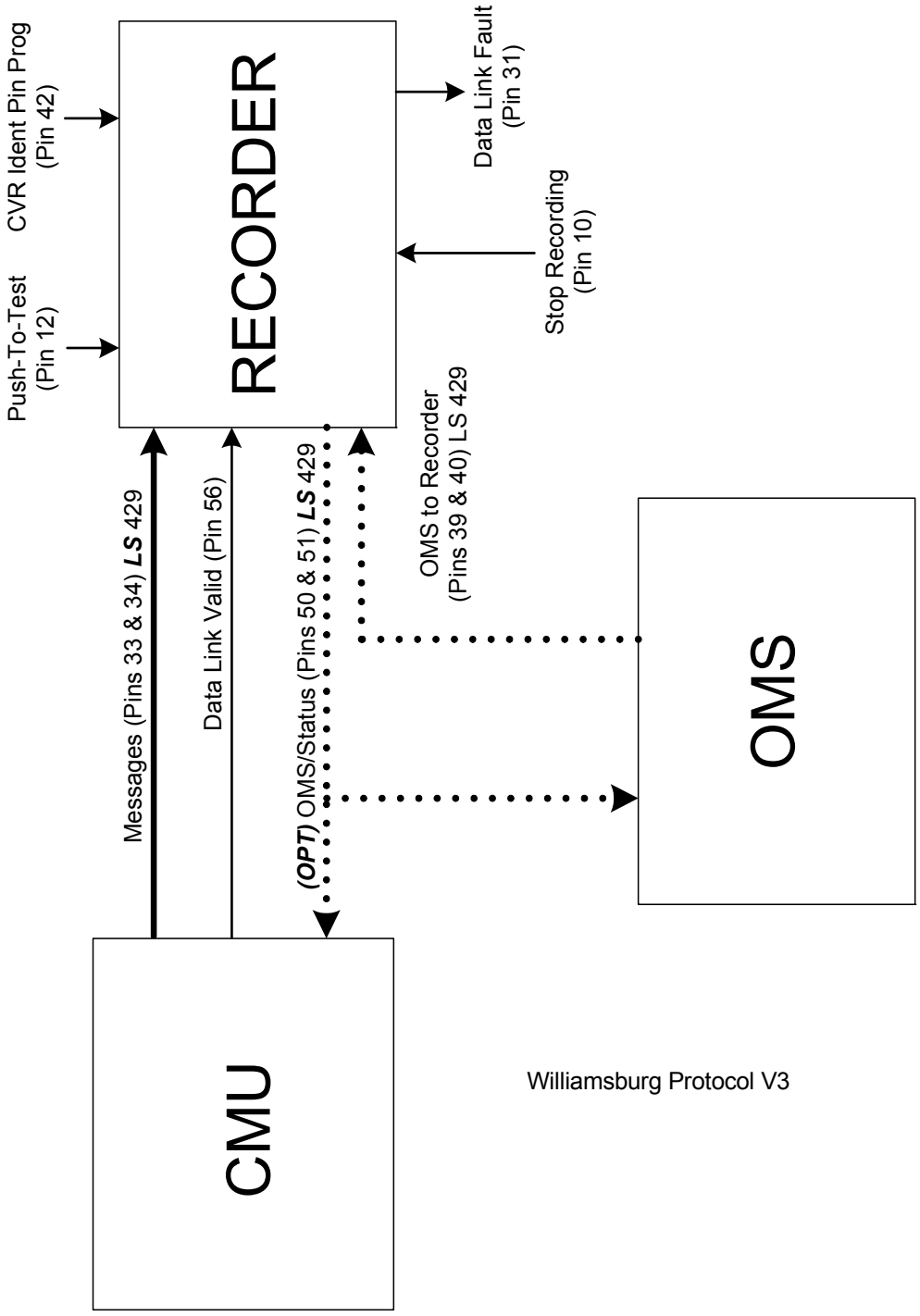


Figure F-1 – CMU Data Link System Block Diagram – (Recorder in CVR Position)

APPENDIX F
GUIDANCE MATERIAL FOR INSTALLATION OF DATA LINK

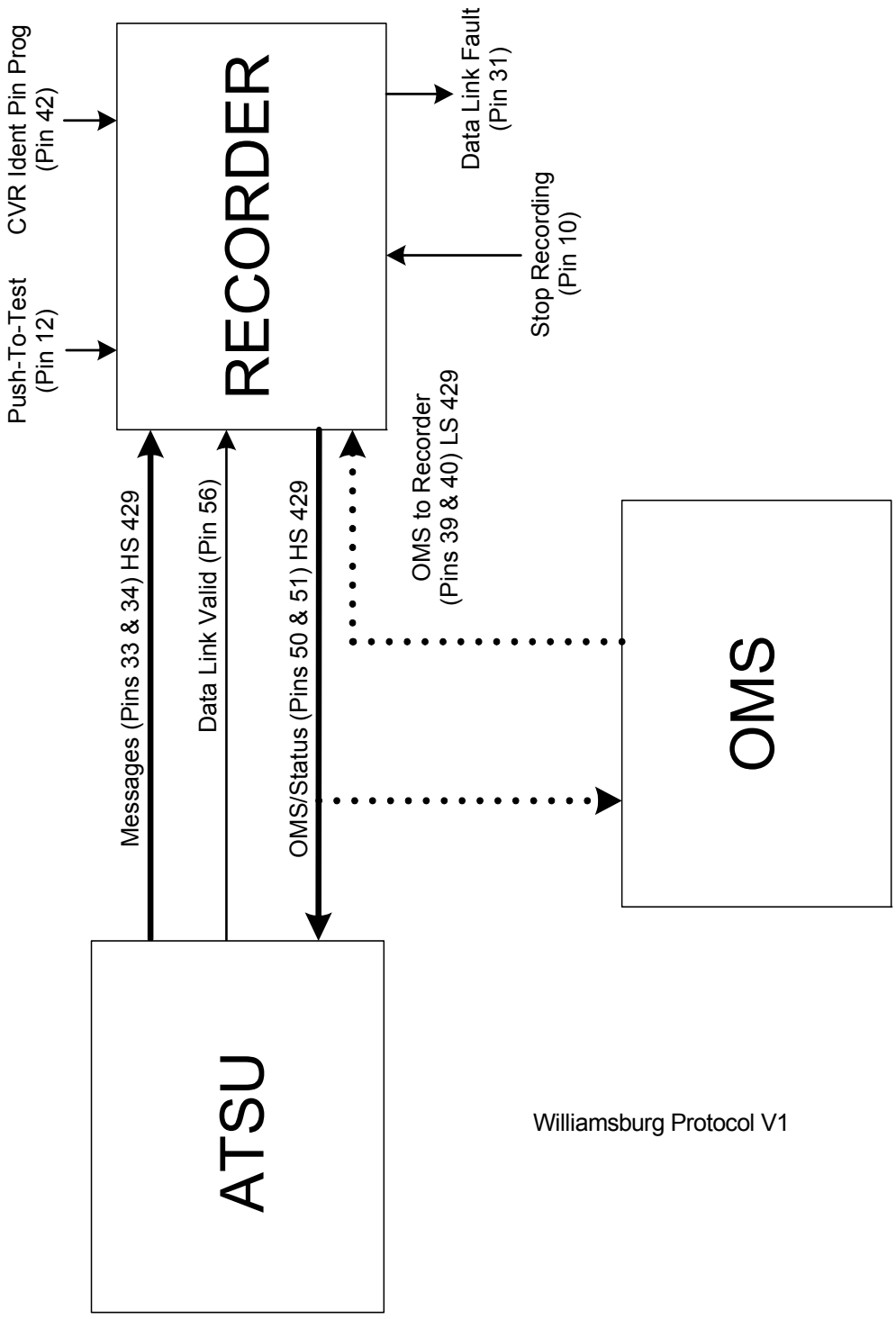


Figure F-2 – ATSU Data Link System Block Diagram – (Recorder in CVR Position)

APPENDIX F
GUIDANCE MATERIAL FOR INSTALLATION OF DATA LINK

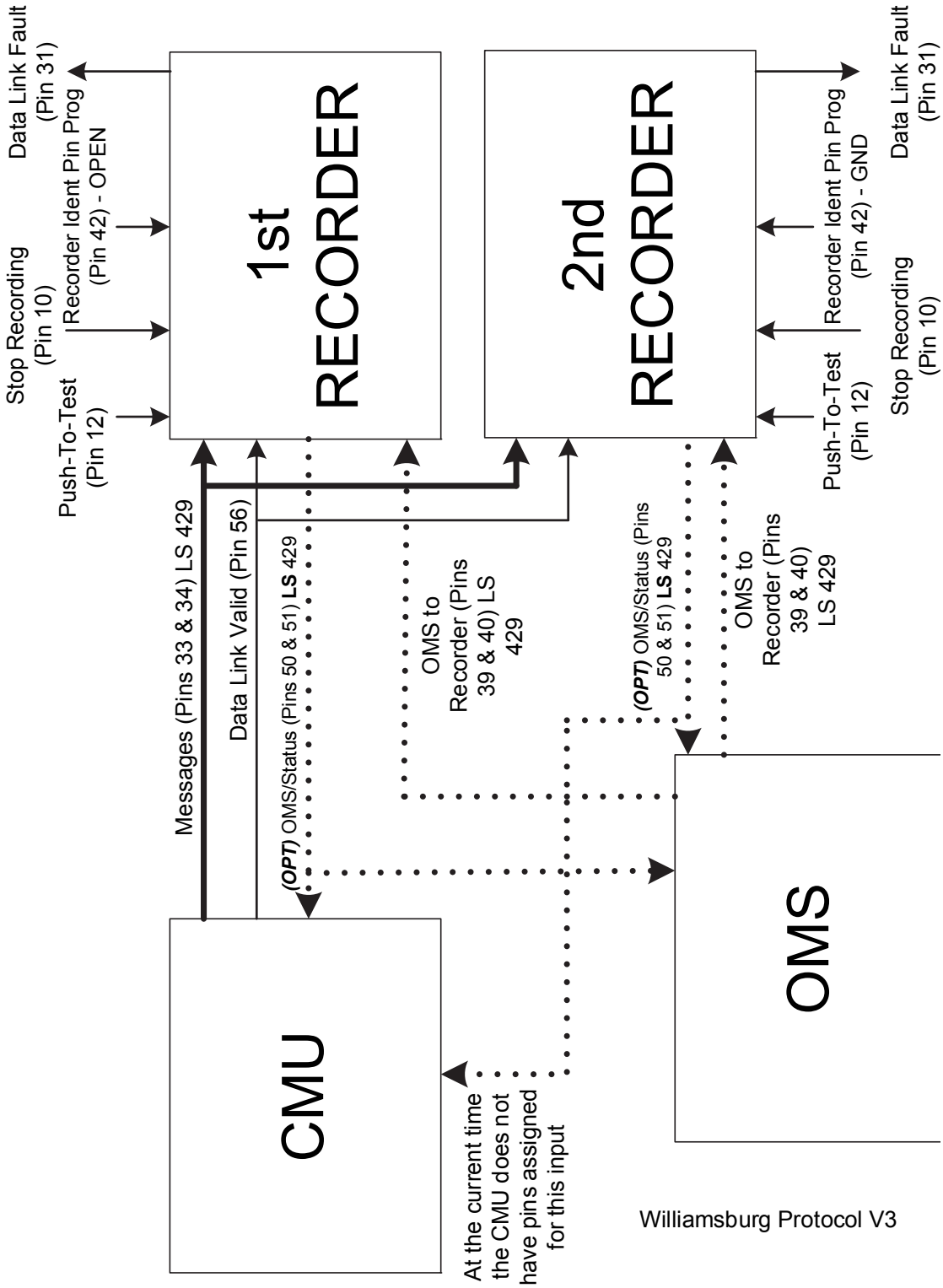


Figure F-3 – CMU Data Link System Block Diagram – Two Recorders

APPENDIX F
GUIDANCE MATERIAL FOR INSTALLATION OF DATA LINK

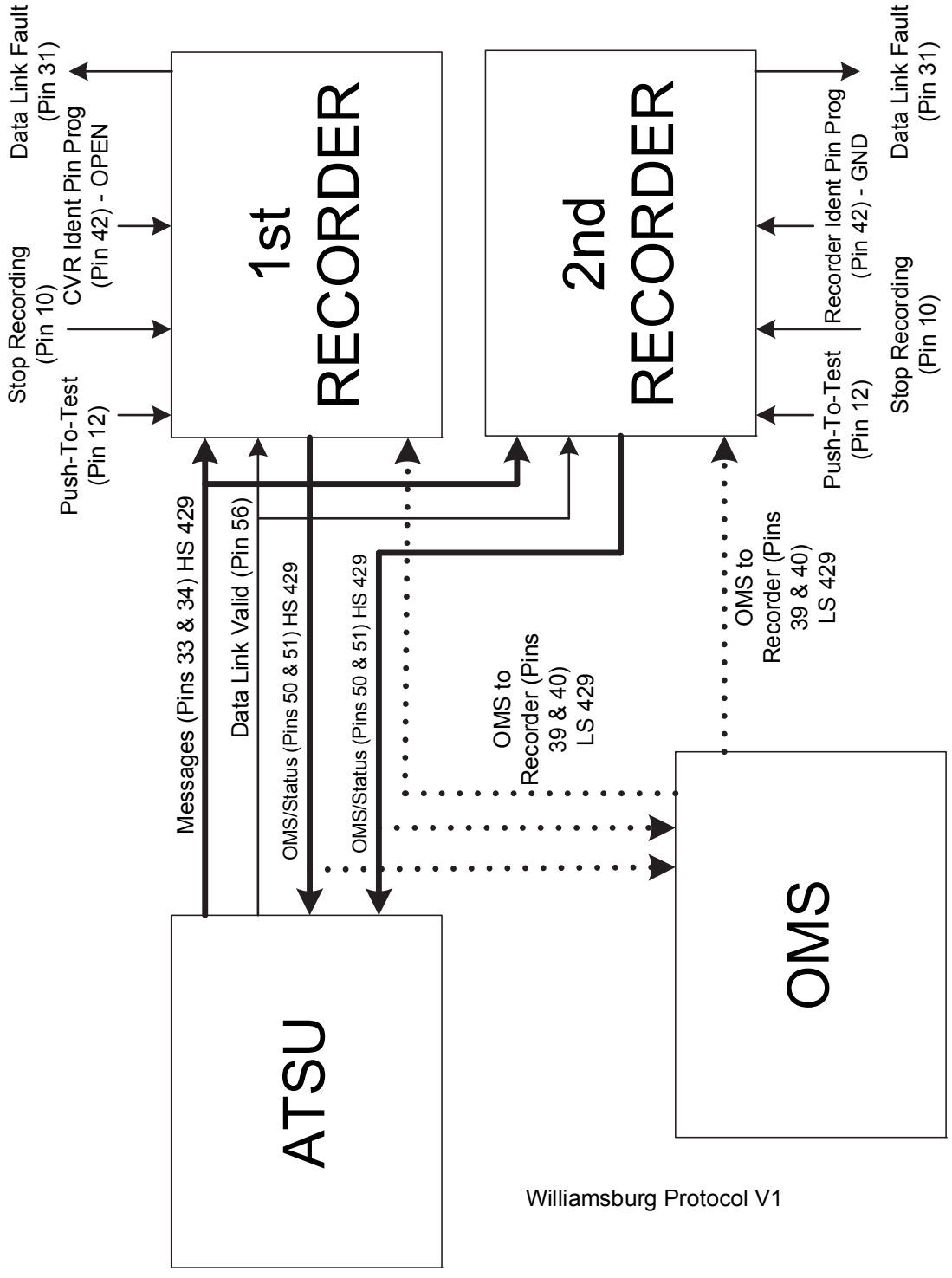


Figure F-4 – ATSU Data Link System Block Diagram – Two Recorders

APPENDIX F
GUIDANCE MATERIAL FOR INSTALLATION OF DATA LINK

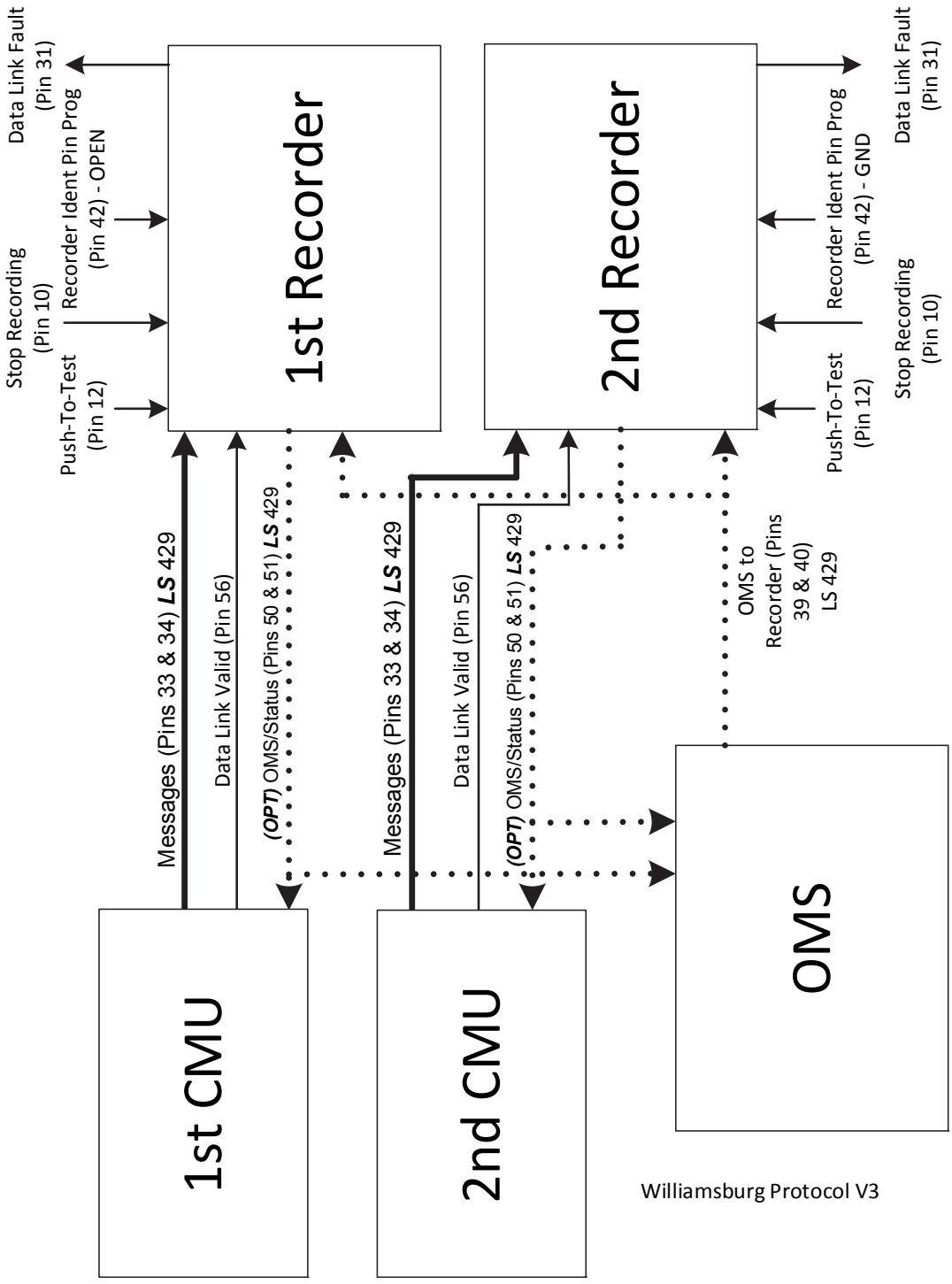


Figure F-5 – Dual CMU Data Link System Block Diagram – Two Recorders

APPENDIX G
ACRONYMS AND ABBREVIATIONS

APPENDIX G ACRONYMS AND ABBREVIATIONS

ACARS	Aircraft Communications Addressing and Reporting System
AEEC	Airlines Electronic Engineering Committee
ATE	Automatic Test Equipment
ATR	Air Transport Racking
ATSU	Air Traffic Services Unit
BITE	Built-in Test Equipment
CAM	Crew Area Microphone
CMU	Communications Management Unit
CU	Control Unit
CVR	Cockpit Voice Recorder
CVFDR	Cockpit Voice and Flight Data Recorder
D/L	Data Link
EUROCAE	European Organization for Civil Aviation Electronics
FAA	Federal Aviation Administration
FDAU	Flight Data Acquisition Unit
FDR	Flight Data Recorder
FSK	Frequency Shift Key
HS	High-Speed
ICAO	International Civil Aviation Organization
INT	Internal
LS	Low-Speed
LSB	Least Significant Bit
LSD	Least Significant Digit
MIC	Microphone
MSB	Most Significant Bit
MSD	Most Significant Digit
na	Not Asserted
N/A	Not Applicable
NCD	No Computed Data
OMS	On-board Maintenance System
ox	Manufacturer Option
RIPS	Recorder Independent Power Supply
S/N	Signal-to-Noise
SDI	Source Destination Identifier
SPL	Sound Pressure Level
SSM	Sign Status Matrix
TSO	Technical Standard Order
UTC	Universal Time Coordinated